THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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Advertisements, new names and corrections to existing entries should be sent in at once.

THE L.C.C.—MUNICIPAL MONOPOLY OR PRIVATE ENTERPRISE?

THE Finance Committee of the London County Council, acting the part of candid friend, has issued a report at an awkward time, when the members are opening their electioneering campaign and putting the electricity supply forward as the principal plank in their platform.

The arguments and warnings contained in the report are those which the opponents of these schemes of municipal trading in electricity supply have always urged, but they come with peculiar force from so important a body within the fold of the London County Council as its own Finance Committee. The majority of the Councillors who favour these great schemes are on the horns of a dilemma, for they cannot meet the position created by the result of their application for powers last session without largely increasing their proposals, and in doing so their Committee reminds them in effect that in avoiding Scylla they will fall foul of Charybdis.

The alleged reason for involving the ratepayers in such an undertaking is to enable them to enjoy the enormous profits which would otherwise go to feed the octopus, promote trusts and all the other iniquitous organisations to which these names are applied; and to prevent monopolies, by creating one vast municipal monopoly.

The Finance Committee pours a cold douche upon the question of relief of rates, by stating that no profits can be expected until two-fifths of the immense generating station is in full operation, and it fears "that during the early years, while the business is being got together, and the undertaking gradually brought into operation, some charge on the rates must be looked for."

Thus the ratepayers are asked to sanction a scheme with the certainty of a present rise in their rates, in the hope of some advantage to be obtained in a distant future. The voters upon such a proposition will most probably act upon the old proverb that a "bird in the hand is better than two in the bush." This is one horn of the dilemma, and the other is that if the scope of the Bill is limited, it will not comply with the suggestions of the Committee which threw it out last year, and the Council will have no excuse, therefore, for incurring the enormous costs of another Parliamentary contest.

The Finance Committee recognises that in the supply of the tramways the Council has a good customer to start with, and probably it would be a prudent course if it limited its business to that requirement and left the general trading to others; if it do not, and if it persevere in the wider undertaking, then it is warned that "under the scheme which has been adopted, the financial responsibilities and risks will fall on the ratepayers of London, whilst the ratepayers of all the large districts outside London within the area of supply will be entirely immune therefrom, although, so far as we understand, the inhabitants of those

districts will receive equal advantages with the inhabitants of the County of London in the matter of prices charged."

In addition to this, the Committee considers that a large reserve fund should be created—a most important provision against depreciation, antiquation and changes of system which is too often omitted—and finally, it suggests that if after all this there is still a surplus, it should be first applied in reducing the price of energy to consumers, so that, as the Committee says, "the prospect of any relief to the rates appears to us uncertain, and in any case remote."

It is well to recall what the suggestions of the Select Committee were when the Bill was returned to its promoters last session. It was recommended that the London County Council should be the authority, but that the provisions of the Bill should be widened so as to enable it to carry out the powers in various ways, thus :—

(*a*) The County Council may undertake the whole work, providing every authorised distributor and every private consumer with electricity in bulk at a maximum scale of prices.
(*b*) The County Council may retain for itself one part of the undertaking, while permitting a private enterprise to undertake another part.
(*c*) The County Council may lease for a substantial consideration the whole enterprise to a private enterprise, to resume possession of it when its initial stages are over.

The report concludes with the remark :—

The financial difficulties, to which we have called the attention of the Council, would, to a large extent, be obviated if the Council saw its way to adopt some scheme of exercising the powers sought if and when conferred by Parliament by which the Council, while retaining general control, would be relieved of the responsibility of working the undertaking in whole or in part.

In spite of this report, the London County Council decided, at the meeting on Tuesday, to proceed with the Bill, and we can imagine, if it get into Committee, how the opposing counsel will revel in the Finance Committee's report, and what interesting cross-examinations may be expected to arise out of it.

In the meanwhile, the scheme is referred to the ratepayers—and will probably influence the elections in March. It bristles with unpleasant possibilities—higher rates, depreciation in the securities of the Council, and consequent increase in the rates of interest on the borrowed capital, and in the terms upon which loans are granted to other local authorities.

The policy of taking over the undertakings of the Borough Councils, in the event of the Bill passing, is not very definitely determined, except as to Marylebone and Woolwich, which are excluded at once ; and the proposal to take over the undertakings of the other Borough Councils *at the amount of their debts* is an original idea which might lead to some interesting negotiations.

It is a common argument among the municipal traders in electricity supply, that when the loans are paid off by the operation of the sinking fund they will possess a valuable asset, and, of course, no debt, besides the goodwill of a profitable business, in which event the purchase for the amount of the debt would be good business.

In opening the Election Campaign, Mr. McKinnon Wood put forward the tramway achievements of the London County Council as evidence of his party's faithfulness to the trust reposed in it, and he somewhat unkindly dealt with the North Metropolitan Co., which for so many years supplied the London County Council with the only profits it ever made ; but he also attacks the London United Tramways Co., and tries to persuade the public that his Council has done better as tramway managers than the excellent service of Sir Clifton Robinson's great undertaking. He compares capital expenditure, but does not point out that the private company had to pay enormous sums for street widenings, while the London County Council charged the bulk of such expenditure to improvements, relieving the tramways capital account in many cases of nearly the whole of it. Then he claims to have realised a larger percentage of profit on the nominal capital expenditure, while charging lower fares.

Mr. McKinnon Wood tries to prove too much, and his extravagant claim to do twice as well with the tramways as the results of private enterprise is too absurd to deceive the ratepayers.

Gas v. Electricity.

In *Cassier's Magazine* recently Mr. G. M. Gill undertook, in an article bearing the appropriate and suggestive title quoted above, to answer the arguments of Mr. A. A. Day in the September issue, regarding the advantages of electricity. For this purpose Mr. Gill cites figures given in the "Encyclopædia Britannica," whence he deduces that with electricity at 4d. per unit and gas at 2s. 6d. per thousand, electric lighting is eight times as costly as gas lighting. He regards this result as "convincing proof" that gas is the cheaper medium, light for light.

It is curious with what persistence the advocates of gas compare the 16-c.p. *carbon lamp* with the 60-c.p. *incandescent gas lamp*. The fact that in the majority of cases 60 c.p. is far in excess of the requirements is conveniently ignored. So is the quantity of gas consumed by the by-pass, which, in the average case of a lamp used for two hours a day, increases the total consumption by at least 20 per cent. Let Mr. Gill replace a 16-c.p. electric lamp with an incandescent gas lamp, with by-pass, and he will find that the ratio falls from 8 : 1 to less than 2 : 1, using the best type of gas lamp and the worst type of electric lamp.

But to be fair, the best electric lamps must be compared with the best gas lamps ; and on this basis, using tantalum, Osram or Nernst lamps, and allowing for renewals, the comparison, *light for light*, is not more than 2·5 : 1, in favour of gas. Where large candle-powers are required, and the arc lamp becomes available, the ratio is, of course, reversed. Moreover, the case for electric lighting by no means wholly turns upon the question of cost.

Dealing with power, Mr. Gill compares the cost of gas, without any allowance for capital charges, depreciation, oil or attendance, with the cost of electricity. He gives the consumption of town gas per horse-power (-hour) at 15 cb. ft., corresponding to full load and highest efficiency all the time, and states that it takes ·75 unit to give 1 h.p. (-hour), without allowing anything for the loss in the motor ; the two errors may perhaps be allowed to cancel out. But the omission of the other important items is fatal to the comparison. It is amusing to note that in Mr. Gill's opinion, in order to compete with gas, the cost of lighting by electricity must be reduced by 800 per cent., and that of power by 100 per cent. In other words, the unfortunate electrical engineer must pay the lighting consumer a bonus of 2s. 4d. with every four-penny unit supplied, and must supply electricity for power gratis. His arithmetical attainments seem to be on a par with his qualifications to appraise the rival merits of gas and electricity.

Electrolytic Corrosion of Pipes.

A recent discussion at the Central States Waterworks Convention, held in Cincinnati, Ohio, indicates that the views of American gas and water engineers on the question of pipe electrolysis are very varied. All were agreed as to the fact that damage to pipes in cities through electrical installations occurs ; but there was very little agreement as to the exact cause of or cure for the action. On the whole, the double-trolley system is pointed out as a certain safeguard ; but the fact that even in Cincinnati, which, owing to the action of the telephone company, uses the double trolley exclusively, a leakage to the water mains has been noticed, does not confirm this view. Other speakers agreed that, though the double-trolley system leads to an improvement, leakages and the consequent electrolysis are still unavoidable in practice. It would appear, therefore, that even underground conduit systems may not be wholly free from danger of electrolysis ; and the question arises whether surface contact systems will prove more or less troublesome in this respect.

Immunity from electrolysis was reported on two single-trolley lines, in which frequent electrical connection between the rail return and the pipe lines had been resorted to.

Freedom from electrolysis in Columbus was considered to be due to the rails being laid in cement instead of on sleepers ; but this acted as a cure only so long as the bonds were in good condition.

THE ACCOUNTS OF ELECTRICAL UNDERTAKERS.

The public have, doubtless, grown accustomed to hearing the finances of the London County Council openly canvassed. The affairs of this body in relation to municipal trading are the subject of everyday conversation; and some of the more inquisitive of the electorate have even ventured to pass judgment upon their tramway accounts. It is even suggested that with a view to making the tramway traffic returns look more favourable, the Council has been tempted to omit from the debit side of its books the cost of street widenings. In the result, while it has to outward appearance run the tramways at a profit, or, at least, not at a loss, its manœuvres have been exposed to the public view.

Tired, no doubt, of being themselves exposed, the County Councillors are anxious to turn the searchlight of public criticism upon the electric lighting companies and their doings. The Highways Committee of the Council recently issued a report, which was printed in our last issue, and in which exception is taken to the financial policy of certain electrical companies. It is alleged that directors' and auditors' fees, salaries and expenses of management, promotion money and interest on loans and advances are being charged to capital account, whereas, in the opinion of the Highways Committee, they should be charged to revenue. It is stated that in taking this course the companies concerned are running counter to the requirements of the Board of Trade auditor.

Two reasons are assigned why an attempt should be made to prevent this action on the part of the companies concerned. In the first place, it is said that the practice in question has a bearing upon the price of supply to the public. Thus, in considering whether charges must be reduced at some time, regard must be had amongst other things to the rate of dividend paid by the company, and if the capital is larger than it should be, the profit distributed will show a lower rate of dividend. In the second place, it is urged that the practice under criticism is of importance to the local authority which may, at some future time, buy up the undertaking of the company. It is suggested that with a view to remedying the alleged evils, the local authorities which may hereafter be at liberty to purchase compulsorily should be allowed to confer with the Board of Trade auditors, and that the Board of Trade be again requested to give further consideration to the suggestion that authority should be sought from Parliament to enforce any objections to the accounts raised by the auditor.

Before discussing the merits of these proposals, let us glance, for a moment, at the statutory provisions which are in force as to the accounts of electric lighting companies. By Sec. 9 of the Electric Lighting Act, 1882, undertakers must on or before March 25th in every year fill up an annual statement of accounts of the undertaking made up to December 31st then next preceding, and such statements shall be in the form and shall contain such particulars, and shall be published in such manner as may from time to time be prescribed in that behalf by the Board of Trade. This section clearly relates only to the *form* of accounts. It says nothing as to whether particular items are to be charged up to capital or revenue. One might expect to find some provision on this head in this Act or the other Electric Lighting Acts, but there is none. The only other provision relating to the accounts of electric lighting companies is to be found in Sec. 6 of the schedule to the Electric Lighting Clauses Act, 1899, which provides that the annual statement of accounts shall be audited by a Board of Trade auditor. It also provides that the Board of Trade may make regulations as to the time and mode of the audit, but it does not enumerate the powers of the auditor, nor does it, so far as we can see, enable him to deal with the question whether any particular disbursement shall be charged to capital or to revenue.

Upon what ground, then, does the County Council found its alleged right to interfere with the manner in which the directors of an electrical company choose to conduct their business? It is said that if a company's capital is increased, the company may appear to be less prosperous than it really is, and that therefore, when the time for revision of prices arrives, the company may be able to put forward a stronger case against the prices being reduced. Our answer to this contention is twofold. In the first place, the prices usually charged to consumers by the majority of companies are very much less than those which they are authorised to charge by their statutory powers; and in the second place, if the question of revision ever does arise, what is there to prevent the Board of Trade from taking into consideration the conduct of the company in charging certain matters to capital account? Sec. 32 (2) of the Electric Lighting (Clauses) Act, 1899, which provides for alteration of prices, contains nothing which would prevent the Board of Trade from taking these matters into account. In the meantime, until it is shown that the consumer is being unfairly dealt with we submit that there is no ground for the interference of the Board.

The second objection, namely, that to lay out capital on things which should be paid for out of revenue will affect the interests of a local authority which may at some future time exercise the power of compulsory purchase, is even more difficult to understand, when we consider the terms upon which companies may be compelled to sell. These are prescribed by Sec. 2 of the Electric Lighting Act, 1888. The short effect of that section is that a local authority must pay the "then value of all lands, buildings, works, materials, and plant of such undertakers suitable to and used by them for the purposes of their undertaking," no compensation being paid for compulsory purchase. We have yet to be told what effect expenditure upon capital account will have had upon the "then value" of the undertaking. That is our short answer to the second point raised by the Highways Committee.

We have said enough to show that in our judgment this is an attempt on the part of the London County Council to divert some part of the current of public criticism from the municipal to the private trader in electric lighting. Let such bodies look to their own before they presume to criticise the methods of others in performing their statutory duties.

PROCEEDINGS OF INSTITUTIONS.

Selection and Testing of Materials for Construction of Electric Machinery.

By Prof. J. Epstein (Frankfort), Foreign Member.

(*Abstract of Paper read before the* Institution of Electrical Engineers *in London, November 22nd*, 1906.)

The material which plays the most important part in the construction of electrical machinery is copper, which must be used in its purest state in order to obtain a good conductivity.

The cross section of round wire is generally obtained by means of a micrometer. In cases where the diameter is very small, weighing may be resorted to. With wire of a section other than circular, allowance must be made for the rounded edges. From a large number of readings taken in the author's laboratory it was found that for the usual sizes of copper strip the cross section may be taken as equal to $(h - 0{\cdot}35) \times b$, where h and b represent the greater and smaller axes of the strip in millimetres.

The greatest accuracy of gauge is required in building a slot-wound armature and in the construction of field coils. The depth and width of the slot are calculated to a tenth of a millimetre, and any irregularities in the dimensions of the copper strips and insulation would make it impossible to fit them in the slots as intended. The speed of shunt-wound motors also depends upon the diameter of the wire on the magnet poles. It is, therefore, absolutely essential that there should be no appreciable variation in the dimensions of the wire.

The specific conductivity of cast copper may vary from about 40 per cent. to 85 per cent. in the Matthiessen scale. When a young laboratory assistant finds the conductivity of a piece of cast copper to be 85 per cent. he will be likely to consider it excellent, but if the experienced workman detects porosity he will rightly pronounce it bad; in such a case, as in many others, one is apt to be misled by a purely physical test made in the laboratory.

Resistance materials, like German silver, manganin, &c., show even greater variations than copper, the specific resistances varying from 0·3 to 0·8 unit.

The variation in the specific resistance above or below normal can be compensated for by increasing proportionally the weight of the material. The risk is less with a specific resistance above the normal.

In contrast with copper, where the purest is the best, the quality of iron is by no means always depreciated by the introduction of

foreign elements. On the contrary, there is great scope for improvement by introducing other substances, such as carbon, silicon, aluminium, &c. Moreover, in the case of iron there are three magnetic and electric qualities of importance, namely, magnetic permeability, magnetic hysteresis, and electrical conductivity.

As long as the magnetic flux is constant, permeability alone is of importance. One can, as a rule, obtain from every good foundry cast-iron suitable for electrical machines.

To a certain extent the quality of the delivered material will necessarily vary, and accordingly we must calculate the ampere-turns for the worst quality expected, and make allowance by constructing the variable field resistance for the best quality. What is, therefore, required and appreciated is an iron of high constant quality.

It is important in comparing the materials and factors of safety to refer to the right factor. In investigating the permeability of ordinary cast-iron, the author would recommend, as a characteristic figure, to take the number of ampere-turns per centimetre required for B = 9,000, and, as regards special steel, those required for B = 17,000. For measuring the permeability of cast-iron and steel the ballistic method appears the most convenient. The magnetisation curve obtained by reversing the magnetising current should be noted; this curve has the advantage over the hysteresis curve obtained step by step, that each point is in itself absolutely correct and does not suffer from cumulative errors.

Besides the physical laboratory tests, the mechanical inspection of cast-steel is very important. For instance, holes in the steel

For practical work it is best to make use of a diagram which shows the losses per kilogramme at different frequencies. To present a comparison of the old with the new kind of iron sheets, the diagram, fig. 2, has been drawn. The curves are plotted for 50 cycles per second, and the lower one is that for a modern sheet of special alloy, while the upper curve represents a sheet which was until lately considered as being of first-rate quality.

Ageing is defined by the German rules for iron as the percentage variation of the figure of loss caused by keeping the sample at a temperature of 100° C. over 600 hours. Fig. 3 shows the effect of ageing with a good and with an inferior sheet of iron, marked B and A respectively. The upper curves refer to the hysteresis, the lower to the eddy currents. From these it is seen that ageing is only due to the rise in the value of the hysteresis. Though at the beginning the figure of loss of sample A is practically the same as for sample B, after a long run it exceeds the figure of loss for B.

There is no difficulty in obtaining ordinary stampings, whose ageing will be within a maximum of 15 per cent.

The testing of the resistance of insulating materials used in the construction of dynamos is not so important as might appear. Insulation difficulties are scarcely ever due to low insulation resistance, but more often to surface leakage, which may be avoided by using only dry materials and by suitable design.

It is necessary, however, to test all insulating materials for disruptive strength, and this constitutes, for high-tension work especially, the most important electrical test. Nevertheless, the more experienced one becomes in the practical testing and theory of

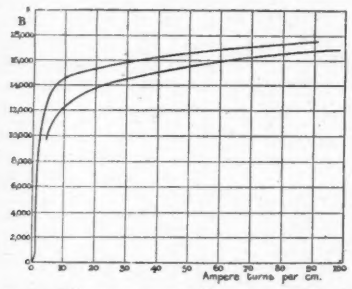


Fig. 1.—Magnetisation Curves of Iron Sheets. The upper curve represents an ordinary stamped sheet, the lower one is that of a modern sheet of special alloy.

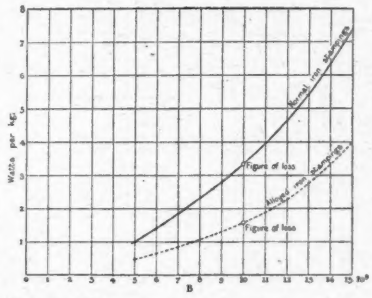


Fig 2.—Curve of Losses for an Ordinary (Normal) Iron Sheet and for an Iron Sheet of Special Composition.

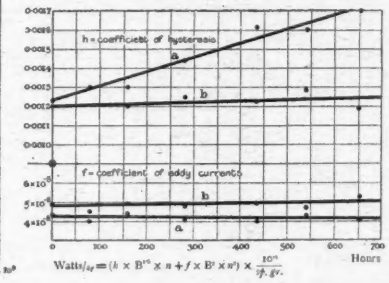


Fig. 3.—Ageing of Dynamo Sheets.

may increase the magnetic resistance of the poles or yoke and cause dissymmetry in the magnetic circuits, which in the case of a continuous-current dynamo will produce sparking or heating in the armature.

Although every magnetic and electric property of the iron sheets used in the construction of armature or transformer cores plays its part, yet the permeability and the saturation are not of such importance, as it is necessary to work with a low saturation of the sheets in order to avoid losses and heating. Extra high saturation will be found in the teeth of continuous-current dynamos. As some special stampings give less hysteresis and eddy-current losses, they may be worked at a higher degree of saturation. Unfortunately they possess a poorer permeability than the old class of stampings. In fig. 1 the upper curve is the magnetisation curve found for an ordinary stamped sheet, while the lower curve is that for a modern sheet of special alloy.

The hysteresis can be measured by taking the magnetisation curve through a complete cycle, and the specific resistance directly by a Wheatstone bridge; but the modern and better practice is to measure the total losses due to hysteresis and eddy currents together, the sample being tested under working conditions.

By varying the frequency, the well-known straight line curves are obtained which discriminate between the losses due to hysteresis and eddy currents at constant induction. The losses themselves are measured with a wattmeter, special care being taken that the instrument is correct for low power factors. As the amount of energy to be measured is very small, precaution must be taken against the occurrence of losses in the instruments.

To get a good commercial average value, the apparatus used by the author is constructed to take a 10-kg. sample, which, according to the rules of the German Committee, must be made up from at least four different sheets. Small samples taken from different sheets, or from different parts of the same sheet, differ sometimes by as much as 20 per cent.

The Verband Deutscher Elektrotechniker appointed a committee which decided to adopt the wattmeter method, and to take as a characteristic the loss measured with B = 10,000 lines per square centimetre and 50 cycles per second. In the German rules this value is called the "figure of loss." The adoption of this standard has proved very useful during the last few years. Since the eddy currents decrease with rising temperature, the figure of loss was determined for a standard temperature of 30° C. The commercial 0·5 millimetre sheets made the last few years changed by about 0·2 per cent. for each degree C., while the modern sheets show practically no variation. Only with irons of analogous composition, the conductivities of which are almost equal, is there any direct proportion between the above figure of loss and the "Steinmetz" coefficient.

disruptive strength, the more difficult it appears to obtain accurate figures which are comparable with those of other investigators.

Most of the high-tension insulating materials, like micanite products, varnish cloth, impregnated paper, &c., are not at all homogeneous. By means of the piercing test the strength at the weakest point is ascertained. The larger the test piece, the greater will be the number of weak points covered, and the greater is the probability of obtaining specially low values. To prove this, the author tested two samples, A and B, of the same material; A was tested with an electrode of 50 × 3 = 150 cm.² and the average piercing pressure was 7,600 volts. Of B, different samples were tested with an electrode of 50 × 62 = 3,100 cm.², and the piercing point was found at 4,000 volts.

The effect of increasing the area of the test-piece is not only to increase the probability of detecting weak spots, but the increase in the capacity of the electrode also has the effect of lowering the piercing pressure. We proved this to our satisfaction by testing to piercing point a sheet of varnish cloth with an electrode of 4 cm.² in 16 places. The mean value of the piercing voltage was 9,900. The same sheet was then further tested, using the same electrode, but with a condenser placed in parallel with the electrodes. This consisted of two plates each about 64 cm.² in area, separated by two layers of varnish cloth. The mean value of 20 readings gave the piercing pressure as 7,250 volts. On placing a second condenser in circuit the piercing pressure sank still further to 7,100 volts.

In the light of these experiments a standard electrode was adopted by the author's firm for testing dielectric strength, which for practical reasons was taken at 25 × 25 = 625 cm². To minimise the local stresses, the edges are rounded off.

The importance of testing most carefully mica tubes for high-tension machinery cannot be too much emphasised. In the Felten-Guilleaume-Lahmeyer laboratory every mica tube is tested up to at least double the working pressure, the tube being covered with tin-foil and filled with metal rods. As the factors of safety taken are so high that failures even under more severe tests very seldom occur, the electric phenomena are controlled by noting the heating effect of dielectric hysteresis.

Fig. 4 shows the difference between two 2-millimetre mica tubes tested under 15,000 volts. The conditions of testing must be identical. For example, when the mica tube is filled with iron rods it becomes warmer than when copper rods are used, for the reason that the heat conductivity of iron is less than that of copper. In the same way the length of the exposed portion of the tube has a distinct influence on the result.

Our standard practice is to fill up the tubes with iron rods and to cover them in such a way that the exposed portion of the tubes equals 20 per cent. of the length under test. About 30 tubes are then laid one against the other. Mica tubes, however, which may

be able to resist this particular test will still be unsuitable for the work if they show inferior mechanical strength or deformation at higher temperatures.

Much has been said about the danger arising from the generation of nitric acid in mica tubes. This phenomenon has also been observed in our laboratory while testing mica tubes filled with cotton-insulated wires under extra high pressure. At first, experiments were made with cotton-covered materials impregnated with different kinds of shellac or paraffin, and the effect in question was soon noticed, even when using the purest materials. Both the thickness of the tubes and the testing pressure were then varied, and tubes of different manufacture were also used. Tests carried out during the last three years have shown that for our practice at pressures up to 10,000 volts, the limits of thickness and of quality to be kept in order to avoid generation of nitric acid lie within the limits which had been adopted by us from other electrical and mechanical reasons.

metres, otherwise they will not stand the mechanical stresses. Thus at lower pressures the factors of safety are unnecessarily high, simply on account of mechanical reasons. The ratio between the thickness and the piercing pressure increases with the former.

Having to take account of the fact that single layers may be faulty, it is necessary to increase the number of layers in proportion as the total thickness of the insulation is diminished.

Again, the weak point of an extra high-tension machine is often not to be found in the insulating tubes themselves, but at the ends outside the slot. This space for a given pattern is about the same in a 1,000 as in a 10,000-volt machine, therefore the factor of safety here decreases as the voltage increases.

Another weak point which becomes apparent with the rise in voltage is the electrical stress between different layers of the single coils; the number of coils being usually fixed by the number of poles, the stresses inside the coils increase with the voltage, and,

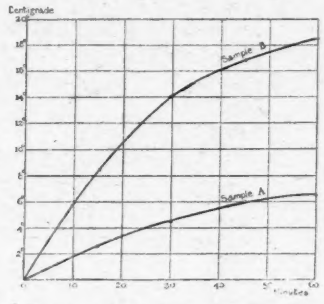


Fig. 4.—Comparative Temperature Rise of Two 2-mm. Mica Tubes when tested at 15,000 Volts.

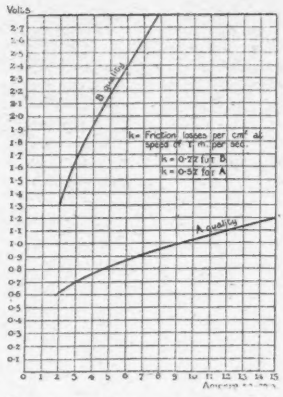


Fig. 5.—Losses found for Two Different Kinds of Carbon.

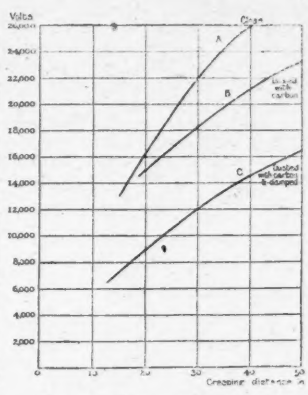


Fig. 6.—Relationship between Creeping Distance in mm. and Pressure, with Clean and Dusted Mica Insulation.

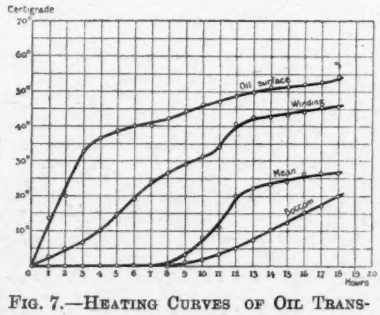


Fig. 7.—Heating Curves of Oil Transformer.

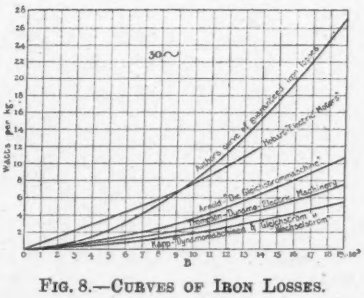


Fig. 8.—Curves of Iron Losses.

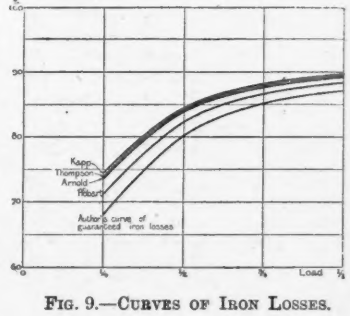


Fig. 9.—Curves of Iron Losses.

In testing carbon brushes the most important details to be considered are durability, absence of any vapours developed through heating, smoothness of running, low friction and low wear and tear, and also the homogeneity of the carbon.

As to electrical features, a high surface resistance may be an advantage in a high-voltage machine, but the reverse in a low-voltage. Fig. 5 illustrates the voltage required for pairs of carbons at different densities of current, and the watts lost by the friction per square centimetre at a speed of 1 metre per second. The figures were taken with a specific pressure of 100 grammes per cm.² Further experiments showed that on a well-polished commutator the A quality carried about 50 amperes per cm.² without glowing, and the B quality carried about 10 amperes, but to be on the safe side we do not work at a higher current density than 9 amperes per cm.² with the A quality, and 4·5 with B. The A quality is superior to B, and though the cost per cm.² is much higher, A would be more economical both in initial cost and in running efficiency. For high-tension work, however, it was found necessary to use carbons of the B quality, as low-resistance carbons gave bad commutation. A sort of laminated brush has been proposed with exceedingly low resistance in the direction of the main current and high resistance in the cross-section. Excellent carbons of this sort have been placed on the market by a British firm.

The chief details to be considered in the electrical testing of complete electrical machines are insulation, temperature rise, efficiency, regulation, commutation and power factor, both for different loads and for overload.

A great improvement was effected by using fibrous materials, such as leatheroid, in connection with low tension and especially with continuous-current dynamos, on account of their elastic and mechanical strength. Mica insulation, which is indispensable for high-tension machines, is excellent when used in thick layers, but on account of its inflexibility and brittleness it is not at all suitable for use in thin layers, especially when it is necessary to bend it.

It is not good practice to use mica tubes thinner than 2 milli-

therefore, the factor of safety also diminishes in this direction as the voltage increases. Accordingly, the test pressures ought not to be in the same ratio for all voltages, and the following rules, drawn up by the Verband Deutscher Elektrotechniker for the testing of insulation of machines and transformers, appear to be of the best practical value :—

Working pressure = P.

For P < 5,000, test pressure applied for ½ hr. = 2 P

„ 5,000 < P < 10,000 „ „ „ „ = P + 5,000

„ P > 10,000 „ „ „ „ = 1½ P.

In first-class works, however, the finished machines are tested at a higher pressure than is provided for by those rules, and the single parts are tested, before being fitted, at a still higher pressure.

The author has never held the view that a high-pressure test weakens a dielectric in the same manner as excessive mechanical stresses weaken an elastic metal. On account of the variation of the dielectric factor of the materials employed and of the geometrical form of the electrodes, the stresses of the dielectric vary, and if there are any points where these exceed the disruptive strength, the dielectric punctures and carbonises. It is, therefore, advisable not to exaggerate testing pressures, but rather to seek safety in well-selected and tested materials, and in careful and thorough construction. In all cases the conscientious building up of the machine on the part of the designer is a better guarantee than the voltage test made on a newly-erected machine. It must be borne in mind that this latter takes place under the most favourable circumstances, while, on the other hand, an experienced designer will consider the unfavourable conditions which may arise in actual practice. To demonstrate the effect of such conditions, experiments were made in our laboratory which are depicted by the curves shown in fig. 6.

Curve A shows the relationship between the creeping distance in millimetres and the pressure, for clean mica tubes.

Curve B the same for mica tubes sprinkled with dry carbon dust.

Curve C that for mica tubes sprinkled with carbon dust and damped with steam.

Although two machines, constructed with different creeping distances, may stand the same normal pressure test, it may be that one is much better suited for practical work than the other. This cannot be ascertained by increasing the voltage of the pressure test.

The only reason why we are interested in the temperature is the harm it may ultimately do to the machine, and especially to the insulating material. From experiments made on samples of cotton-covered wire by the National Physical Laboratory of Great Britain, 125° C. was taken as an approximate safe limit. With an engine-room temperature of 35° C., there would thus be left a margin for heating of about 90° C.

The temperature of the outside of the machine is easily measured with a thermometer; the temperature inside the coils varies to a great extent with the construction. Even though we cannot measure the maximum temperature inside a machine, when the latter has been built—and strictly speaking this is what interests

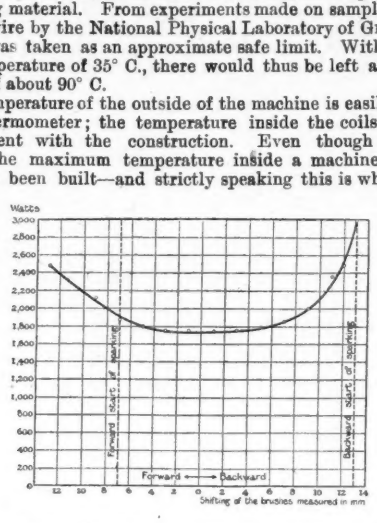


Fig. 10.—Curve showing Effect of Varying Position of Brush Gear.

us—the change of resistance offers a very convenient means for ascertaining the mean temperature. According to the Regulations of the Verband Deutscher Elektrotechniker the average heating of magnetic coils is measured by this method. A mean temperature rise of 60° is permitted, which corresponds to an increase in the resistance of 24 per cent. This mean value also corresponds, as a rule, to a temperature rise of 40° C. at the exterior, measured by a thermometer.

With armatures there is no material difference between the inner and outer temperatures, since the winding consists only of a very few layers. The German regulations, therefore, provide in these cases for thermometer measurements. They limit, however, the permissible temperature rise to 50° C.

As to the influence of time, the temperature of small transformers becomes stationary after a 16-hour run, that of alternator coils after a 6-hour run.

The temperature rise in an oil transformer can be seen from fig. 7. Here the lower parts do not heat at all at the beginning of the test. The lower the thermometer is placed the greater the difference between the temperature rise obtained after a few hours' run and the stationary value.

It is impossible to establish a universal ratio between the temperature rise after continuous running and after a 6-hours' run. It is desirable, therefore, in drawing up general rules, that these should not refer to any arbitrary time, but to the stationary temperature after continuous running.

If there is no opportunity for fully loading the machine, an idea of its thermal characteristic may be obtained by the well-known method of running it alternately with a higher voltage and with a higher current, so that in each case the full losses are obtained.

The object of the heating test is solely to ascertain that the recognised standard limits for the heating are not transgressed. Whether the temperature of a machine increases 20° C. or 50° C. is otherwise wholly immaterial, and it would be entirely premature to draw a conclusion as to the ample design of the machine from the increase of temperature alone. A low temperature rise is of no practical value if the machine cannot be overloaded owing to its commutator beginning to spark, its regulation being insufficient, or perhaps on account of its mechanical construction, or owing to its being driven by a gas engine.

The efficiency of electric machines is defined by the ratio between input and output of energy. More accurate results are obtained by testing the losses than by comparing input and output. For supposing that the efficiency may be about 90 per cent., an inaccuracy of 1 per cent. in measuring the losses will influence the value of the efficiency only to one-tenth of 1 per cent., the losses themselves being about 10 per cent. of the input.

To check the copper losses at full-load in armatures, the resistances ought to be measured after a regular normal run. Special care must be taken with continuous-current armatures in regard to the different brush contacts, and to the exclusion of the contact resistance of carbons.

What are guaranteed as iron losses in machines are not the losses which occur in the unfinished iron, when the lines of force are uniformly distributed in exactly the way which the designer has prescribed in the armature core, but the additional losses due to varying density, dispersion, and, above all, to hysteresis and eddy current losses in other parts of the machine, whether solid or laminated.

We, therefore, see that to calculate the iron losses of a machine we must base our calculations on curves of losses as determined from actual machines, which will be found to differ to a very considerable degree from those deduced from theoretical considerations.

In illustration of this some curves of iron losses are given in fig. 8, which are taken from a few of the best standard works on electrical machine construction. The figure also contains a curve of loss, designed by the author as a basis for guarantees. Naturally the efficiency which has been calculated for a certain machine is very greatly affected by the choice of the curve of iron losses. The curves in the next figure (fig. 9) have been taken as a basis for the calculation of the efficiency of a certain machine. As may be seen, differences occur of 3 per cent. at full load and of 5 per cent. at half load.

In order, then, to establish a comparison of guarantees as regards iron losses and to enable any one to judge the comparative value of different machines, it is essential that these guarantees should be calculated on identical lines. Because otherwise, in specifying the efficiency of a machine, a low efficiency is often not so much due to the fact that the machine offered is an inferior one as that the specification has been worked out in a more thorough and conscientious manner.

With continuous-current machines special care must be bestowed on the position of brushes. Fig. 10 shows the variation of the iron losses observed on a machine running as a motor with different sparkless positions of brushes.

If the voltage available differs a little from normal a correction may be made, assuming that the losses vary with the square of the voltage. This assumption is correct in most cases.

Testing is simplified if the efficiencies of engine and generator are not guaranteed separately but combined. In this case the result will be obtained by indicating the engine and measuring the output of the generator. The simplicity of this method, and the importance of the result of this test for the buyer, have brought it into frequent use.

Though the accuracy of electrical measurements is much higher than that attainable in other branches of engineering, we must bear in mind that it is not absolute. Even with continuous-current tests special care is required to measure current or voltage within 0·5 per cent. In dealing with high-pressure wattmeters, it is very difficult to get within 1 per cent., though the readings may be accurate within 0·1 per cent.

Taking into account the inaccuracy of mechanical measurements, it appears absolutely necessary in the case of efficiency tests to allow a margin of error, up to 2 per cent. being commonly agreed upon. Even higher margins must be allowed in hydro-electric plants, particularly when working with a small head of water.

There is no difficulty in ascertaining power factors. The simplest way to obtain the power factor is by the 2-wattmeter method. Slight inaccuracies of the wattmeters may be eliminated if necessary by interchanging them.

There is no doubt that the greater the value of cos ϕ the greater the advantage to the owner of the machine, and particularly to the supplier of energy, but in considering the question care must be taken that it is not attained by reducing the air-gap to too fine a degree.

With an alternating current the regulation is defined as the percentage drop of the voltage between no-load and full-load current with a certain power factor. In the case of transformers, however, it is usually ascertained by short-circuiting the secondary by an ampere-meter and observing in the primary the voltage required to give the normal amperes. But as a particularly good regulation is essential with transformers, it should not be obtained by reducing to a minimum the distance between the high and the low-tension coils. In comparing transformers for a very high voltage the author would prefer one with ample distance between the high and low-tension coils, even if the regulation were poorer. Apart from special cases, such as machines for electric furnaces or tramway machines to work in parallel with buffer batteries, the closer the range of the regulation of generators the better.

The overload capacity for motors must be tested as regards both starting and running. In calculating the torque of alternating-current motors, one must not lose sight of the fact that if the torque varies with the position of the rotor, the user has to reckon with the lowest value.

The overload capacity of alternating-current motors is often ascertained in the simplest way by lowering the voltage until the motor ceases to run. In motors for pumps, fans, ventilators, and such-like, where a variation of the torque will never occur in actual service, it is this overload capacity (stability when the voltage falls) which is of chief importance to the user.

Machines, as a rule, are not intended to run with a continuous overload, though it may be important for them to be able to do so for a short time. According to the German Regulations, machines should, as a general rule, be tested with a 25 per cent. overload for half an hour, and with 40 per cent. overload for three minutes.

With continuous-current machines, the maker must devote attention in designing a machine to making it run absolutely sparklessly.

No doubt a sparking machine is bad; but even if the machine under test does not spark, this does not mean that it is good. It often happens that a machine which runs, say, fairly well to-day will give trouble after some months of actual work. What is required, and what cannot be checked by a mere test, is reliability. This reliability, in the first place, is guaranteed

by the strength of the mechanical construction. A machine running under good mechanical conditions may give trouble if these conditions change through wear and tear, just as, in testing the materials for a machine, we must not lose sight of the fact that the electrical part, although important, is only a part, and that a machine, to be good, must be sound from both an electrical and a mechanical point of view.

Efficiency as far as motors are concerned is very important in connection with a central station, where you have to pay a high price for power, but as regards generators this point is often overestimated. It does not pay to trouble about one-tenth of 1 per cent. if it cannot be checked with accuracy and if you are losing efficiency in your engine and boiler house. Insist upon efficiency in your boiler house and renounce a few tenths per cent. of efficiency in your machine, if by this it can be improved as regards regulation, overload capacity or safety. For instance, we often decrease to a great extent the efficiency of low-tension direct-current machines by increasing the number of brushes. With a lower number of brushes the machine would stand all that is required by the specification, and all that can be checked by the test, but we prefer a machine fitted with a greater number of brushes, as it will stand both an overload and bad attention.

From the foregoing observations it is clear that one must not depend only upon measurements in order to form a due estimate of the capabilities of a machine, nor must one regard it as a better machine the better the values that are obtained. Such theoretical calculations must always be supplemented by taking due account of the constructive details of the machine, and also of the experience gained from acquaintance with machines of similar construction and origin. Hence the importance of selecting the most suitable materials and of testing them in a practical manner.

Discussion.

Mr. Skinner, Westinghouse Co., Pittsburg, in opening the discussion, said that present practice was to produce a cheap machine, which demanded a close knowledge of materials. He could hardly believe the author would agree to a temperature rise in machinery of 90° C.; in his experience 40° C. was a limiting rise, and the tendency was to force it down to 30° or 35° C. He had found it necessary to have specifications agreeable both to producers of material and manufacturers of machinery in order to obtain satisfactory results.

Mr. W. H. Patchell deplored the absence of manufacturers from the meeting, and commended Prof. Epstein's way of using commonsense, instead of higher mathematics in dealing with his subject. The author had referred to the occurrence of surges. He supposed pressure surges were referred to, but judging from his experience in the running of plant, it was necessary that manufacturers should take into account current surges. He was of opinion that it was possible to strain a dielectric in testing—possibly incipient carbonisation might be set up which would weaken the insulating properties. In reference to the relation between creeping distance and pressure shown diagrammatically by the author, Mr. Patchell considered that time would have some influence in this; he also thought that a reference to the size of the oil transformers tested by the author, would have enabled members better to appreciate the results given, and remarked on the uneven temperature rises shown. He thought that sometimes too much importance was attached to guarantees—the personal constant of the firm tendering was equally important, as it was in many cases impossible to check guarantees.

Mr. J. S. Peck (British Westinghouse Co.), referring to numerous points in the paper, said that high permeability was sometimes very important, particularly when they had so low a frequency as 15 cycles. He thought 100° C. too high a temperature at which to age iron; 85° C. was a fairer temperature, as machines did not often run at 100° C. The one use of insulation tests was in detecting the presence of moisture; nitric acid troubles, in his opinion, did not arise from brush discharge but from some simpler cause, and would not occur where the insulation was fitted for ordinary working conditions. He deprecated the use at the present time of high-density brushes as they were unsafe, and he disagreed that mica was an essential to the construction of high-voltage machines. Some makers had eliminated it, and some used paper and mica. Leatheroid had its good features, but it must be kept moist otherwise it turned brittle. He was opposed to low-voltage long-time testing of machines, as machines usually broke down with a high-voltage instantaneously applied, and the latter condition was essential in testing, to be fair. He agreed that the temperature measurements of machines should be taken after becoming stationary, and not when they were highest. In regard to the author's temperature tests of oil transformers, Mr. Peck took exception (from his extensive transformer experience) to the hump in the temperature curves, which might be due to an error; he also considered 54° was not a final temperature, he judged the latter would go on rising for several hours. The author had mentioned that the accuracy of mechanical measurements of machine efficiency was much behind electrical; he thought that there was no other way of measuring in certain cases, as, for instance, where machines were built in position.

Mr. E. H. Rayner queried the author's methods in regard to the piercing tests, in view of probable errors; in the case of material under prolonged stress he supposed the damage was visible. He proceeded to give briefly the results of researches into the temperature rise in field coils with various coverings, &c.; and pointed out that in regard to temperature measurements of machines, where the latter were mechanically ventilated, the outside temperatures, after stopping frequently, got higher, owing to the heated air passing out.

Mr. S. Evershed bewailed the difficulties of instrument makers, who had to make three or four times the number of tests, as compared with makers of large plant, and often dealt with total sizes less than the errors allowed in large work. Referring to a special iron alloy introduced by Messrs. Sankey, which diminished hysteresis and eddy-current losses, due, he thought, to increased specific resistance, it appeared to be identical with Prof. Epstein's sample, for which a curve of losses was shown in the paper. Insulation tests revealed the soundness of material; he thought high pressure tests might result in overstraining, and they couldn't say that it didn't.

Mr. W. M. Mordey, in a communication, referred to the steel-alloy introduced by Hadfield and Sankey, and supplied by the latter; its properties made it very useful in transformer and alternator work.

Mr. Val. Fynn, on the question of machine testing, commended an overall efficiency test, and Mr. Irwin described a method of analysing the losses in direct-current machines.

Prof. Epstein, who decided to communicate his reply in full, pointed out that in the oil transformers mentioned in his paper the upper oil was heated in the first instance, and it was only after some 5 hours that a rise in temperature occurred half-way down the case. Temperature rise had nothing to do with the size of the transformer, it depended only on the heat capacity of the materials of construction. He concluded by a brief reference to the question of piercing pressures, pointing out that he had measured the voltage in the H.T. and intended to make further investigations of the matter.

The meeting closed with a few remarks from the President on the research work carried out by the National Physical Laboratory in this connection.

Physical Society.

At the meeting held November 23rd, 1906, Prof. J. Perry, F.R.S., president, in the chair. A paper on the "Electric Radiation from Bent Antennæ" was read by Dr. J. A. Fleming, F.R.S. Mr. Marconi showed that if a vertical radiator earthed at the lower end was bent over so that a short part was vertical and a much longer part horizontal, it radiated less vigorously in the direction in which the free or insulated end pointed than in the opposite direction. He (Dr. Fleming) had shown mathematically that this difference depended upon the ratio of the wave-length of the radiated wave to the distance between the radiator and receiver, as well as upon the ratio of the lengths of the horizontal and vertical parts of the antenna. Mr. Marconi had operated with waves of about 150 metres wave-length, but it appeared desirable to test the theory and the expressions given by the author for the electric and magnetic force round such a bent antenna by making experiments with shorter wave-lengths and correspondingly shorter distances. The paper is accordingly occupied with an account of experiments made during the past summer in the quadrangle of University College, London, with radiating antennæ consisting of wires bent in various ways, which have the property of radiating electric waves more strongly in some directions than others. The receiving arrangement used was first described. It consisted of a thermo-electric oscillation-detector contained in a double test-tube, like a Dewar vacuum-vessel as used for collecting liquid gases. Four copper strips pass down the inner tube, and platinum wires soldered to them are sealed through the glass. One pair of these are connected by a fine constantan wire about 0·02 mm. diameter, and the other pair are connected by a tellurium-bismuth thermo-junction which just touches the centre of the fine wire. A high vacuum is made in the space between the test-tubes. If electric oscillations are sent through the constantan wire and a suitable galvanometer connected to the thermo-junction, this receiver affords a means of measuring the root-mean-square value of the oscillations induced in any receiving antenna when the fine wire is inserted between the antenna and the earth. The receiver used gave deflections almost exactly proportional to the square of the current passing through the fine wire. This receiver was inserted between an earth-plate and a vertical receiving-antenna consisting of a double copper wire 20 ft. high with a small capacity-plate at the top. The transmitting antenna consisted of a similar wire and plate so supported that it could be bent over at any required height above the ground and the horizontal part swivelled round into various azimuths. Readings were taken of the current in the receiving antenna, and plotted out as polar curves corresponding to the various directions of the free end of the transmitter. Curves are given in the paper showing the form of the polar curve when the 20 ft. transmitting wire is all vertical or bent over at a height of 1 ft., 2 ft., 3 ft., 4 ft., 5 ft. and 10 ft. respectively from the ground, and these show that the intensity of radiation in various azimuths for constant distance between receiver and transmitter becomes more unequal as the ratio of horizontal to vertical part of the transmitter increases. Also all the polar curves show a minimum radius vector or radiation corresponding to a direction of the free end of the transmitter such that it makes an angle of 70° to 75° with the line joining the earthed points of the transmitter and receiver. This is shown to be entirely in accordance with the theory given by the author.

The paper concludes with an explanation of similar effects observed by Mr. Marconi in the case of bent receiving antennæ; and it is shown that these effects cannot be explained without admitting three sources of electromotive force in the bent receiving-antennæ—(1) that due to the magnetic force of the incident wave, (2) that due to the electric force, and (3) an electromotive force due to the periodic insertion and removal of lines of magnetic force from the nearly closed loop formed by the bent antennæ. Generally speaking, all the directive effects found to be associated with bent

transmitting and receiving antennæ, as used for wireless telegraphy, are explicable on the basis of the theory expounded by the author in the above-mentioned mathematical paper. The important bearing of these facts and observations on the problem of directive electric wave telegraphy was also pointed out.

A paper entitled "Auroral and Sun-spot Frequencies Contrasted," was read by Dr. C. Chree.

A paper "On the Electrical Resistances of Alloys" was read by Dr. R. S. Willows. Lord Rayleigh has given a theory intended to account for the high resistance of alloys compared with that of the constituent metals (*Nature*, June, 1896, and Collected Papers, Vol. IV, p. 232). According to this theory, when a current is sent through an alloy it sets up a series of Peltier effects at the junctions of the dissimilar metals, and hence also a back E.M.F. Since these effects are proportional to the current, they are indistinguishable from a resistance under ordinary conditions. It is this spurious resistance that may account for the difference in behaviour of an alloy and a pure metal. The author attempted to put this in evidence by measuring the resistance of an alloy with direct and also alternating currents. At the instant of reversal of the latter the back E.M.F. will assist the external E.M.F., and hence more current will pass, *i.e.*, the resistance will apparently be reduced. A bridge method was used, the frequency varying between 10-989 per second. No spurious resistance could be detected. If it were present its temperature coefficient would probably differ from that of a pure resistance. The method was therefore used between temperatures 100° C. and that of liquid air, but again with negative results. A minimum accuracy of 0·02 per cent. was attained.

Prof. J. A. Fleming said Lord Rayleigh's theory was ingenious, but it pre-supposed a coarseness of structure in the alloy. An alloy was probably a substance of the nature of a solution with a fine structure, and it was difficult to see how thermo-electric E.M.F.'s could be brought into play without discontinuity of material.

Mr. A. Campbell said that shortly after Lord Rayleigh advanced his theory he made some experiments to try to detect if alloys showed changes of resistance when tested with alternating and direct currents. The alloy selected was ferro-nickel, as it was expected that this would show the effect strongly, as the constituents give a strong thermo-electric E.M.F. No difference could be detected between the apparent resistance with the direct-current and with alternating-current of frequencies up to 80 per second (the usual correction for contact difference being found and applied).

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Combined Time Meter for Tramways.

The method of checking current consumption in tramway working by means of time meters is the only one feasible at the present time, and more attention is, therefore, being given to this system of controlling drivers of cars. Up to now the practice has been to use one time meter on every car; this answers the purpose wherever cars are equipped with one motor only. For cars with two motors, a time meter is required that distinguishes between running in parallel and running in series, for it is found in practice that a motorman can falsify his records by slipping in a good deal of parallel running when he thinks he is not observed, and in that way giving as good a record as another man who is a far better driver. To make this system perfect, the Acme Meter Co., of 46, Queen Victoria Street, E.C., whose time meter for single motors is already known, have brought out a combined time meter designed on the above-mentioned principle. This instrument allows the control of both motors on separate dials, and avoids the trouble of installing two instruments for which, as a rule, there is no room on tramcars.

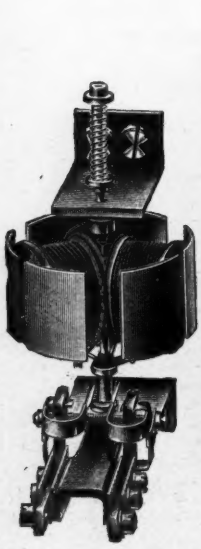


Fig. 1.—The Trident Armature.

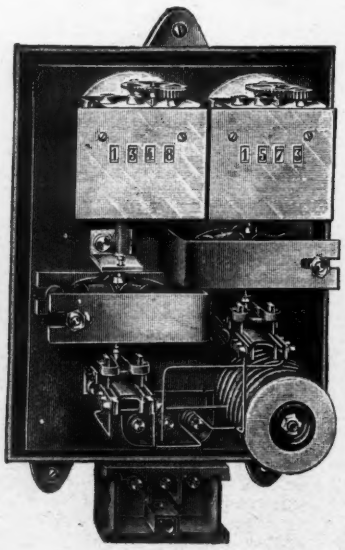


Fig. 2.—The Acme Time Meter.

This combined time meter will be useful on most tramway systems. If one takes the ordinary town tramways, there is always a certain portion of the denser districts where it is impossible for a man to run on the parallel notches, except to be constantly throwing on and off; series running would give just as efficient time-keeping in these parts, and with greater economy in power consumption. If a motorman is not restricted on his parallel notches he undoubtedly, in such cases as this, uses them frequently, and the result is that he is always speeding up and braking his car. Instances are known of a reduction in power consumption of some 25 per cent. by restricting the parallel notches, except where they can be used on good long straight stretches and no frequent stops are required. The personal element varies considerably with different motormen, and the time meter is an excellent means of controlling it.

We understand that the "Acme" time meter registers correctly with a variation of voltage of 20 per cent. on either side; it will, therefore, record the time not only when the full series and full parallel notches are on, but also when a man is on the resistance notches. A careless man will, undoubtedly, keep on these longer and, therefore, work less economically than another man who is smarter. The "Acme" time meter will show the difference between these two classes of men also.

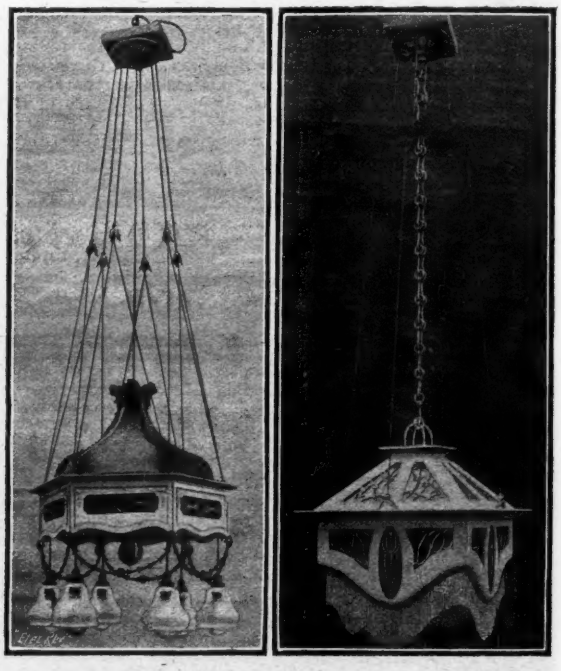
Fig. 2 shows the apparatus without the cover. The two time meters are fixed side by side on a common base; they are started by a small electric motor, whose armature runs in the stray field of a permanent magnet. Fig. 1 shows the trident armature. Special attention has been given to the construction of the brushes, so that they should be able to withstand the greatest possible vibration. The two clockworks of the time meter are of the simplest construction. The escapement is connected with the motor by means of a flexible shaft; the clockwork has springing figures.

The meter consumes only 8 milliamperes; the potential difference of the brushes is 4 volts.

The meter can be fixed anywhere on the car; it weighs about 4½ lb., and its measurements are:—Height, 5½ in.; length, 9 in.; depth, 4½ in.

"XL" Electric Stoves and Wooden-Metal Fittings.

Messrs. O. C. Hawkes, Ltd., of 69 and 70, Aldersgate Street, E.C., whose convector electric stoves have already been described in these pages, are issuing some special literature relating thereto. One of the pamphlets is an abridged price list containing seven designs of the cheapest forms of "XL" induced draught electric stoves, particularly adapted for use by central station men. It gives a range of cheap stoves in attractive form, and briefly explains the advantages of the system. It is neatly produced, and is intended to be of service to the commercial departments of electricity supply undertakings. The other pamphlet is designed particularly for distribution amongst consumers, and deals with the cost of installation of stoves in a general way, and aims at guiding the intending



Hawkes's Wooden-Metal Electric Fittings.

customer into the right track in arranging for the installation of electric heating. The company is also issuing a postal card among the trade for the purpose of keeping the XL stoves in their mind.

We recently had an opportunity of seeing the various manufacturing operations in connection with these stoves at the firm's Globe Works, in Bromsgrove Street, Birmingham. We learned that the demand for them had been so great as to exceed all anticipations. We were interested in watching the art-metal workers engaged in the production of the beautifully designed hand-hammered framework which has characterised the XL stoves, and also the production of the electrical interior made on the firm's patent principle. Our readers may remember that these stoves are designed to draw the air of the room in at the bottom, raise its temperature to 400-600° F. and emit it at the top. The arrangement secures the greatest possible current density in the interior, and therefore the greatest possible concentration of heat without the disadvantage of buried wires. It is claimed that a standard stove will raise a thermometer 10° F. in a room of average size, in a quarter of an hour. It is the custom of Messrs. Hawkes to stamp the amperes taken to produce a required temperature on the back of each stove; some were under test in the test-room at the time of our call. All of Messrs. Hawkes's radiators are not made of ornate design—some plainer and cheaper examples are made for factory service in assembling and other shops.

An admirable display of these stoves is to be found at the firm's Aldersgate Street showrooms. By the way, it is Messrs. Hawkes's intention to concentrate all their electrical business at this address, and new floors are being taken with that object, but Birmingham will continue to be their manufacturing centre. The firm's long-standing reputation for artistic wood, metal and glass work has afforded it a full justification for taking up the design and manufacture of electric light fittings. From the variety of examples shown, it is clear that they have left the beaten path in this matter of wooden fittings, and have hit upon a happy combination of art metal and wood, which gives a distinctly lighter effect. A couple of such specimens are shown in the accompanying illustrations. These, we believe, will be found to be quite unusual, but they are thoroughly representative of the original and pleasing work of which Messrs. Hawkes are making a speciality. Many of their fittings are attractively relieved with enamels and repoussé work, or with art colouring decoration effected by means of powdered glass.

An Automatic Time Switch.

Mr. G. Braulik, of Upper Thames Street, has recently introduced an ingenious little automatic time switch for preventing the excessive use of electrical energy by irresponsible persons in such situations as lavatories, bedrooms, corridors, cellars, &c.

The operation of the device depends on the heating up of a compound metal strip, which, in expanding, breaks a contact, compelling the current to use an alternative path round an electro-magnet, which is connected in parallel. The magnet and its armature effect the switching over or cutting off of the installation according to the type of switch selected.

The construction of the device is simplicity itself; it is adapted for either direct or alternating current (110-250 volts), and with its reasonable price and convenient size (2½ in. diameter × 3 in. wide) it should find a place in many installations.

LEGAL.

Attorney-General *v.* The Mersey Railway Co.

Judgment was given on Tuesday last week, in the appeal of the defendants in this case from a judgment of Mr. Justice Warrington, who came to the conclusion, with reluctance, that the omnibus business of the defendants was not incidental to, or consequential upon, their business as a railway company, and granted a declaration and injunction as prayed. Hence the present appeal of the defendants.

Mr. Upjohn, K.C., Mr. Norton, K.C., and Mr. Shaw appeared for the appellants; and Mr. Cripps, K.C., and Mr. Leslie Scott for the respondents on the appeal.

Lord Justice Vaughan-Williams, in giving judgment, said the real position taken up by the defendant company was that it did carry on the business of omnibus proprietors *bonâ fide* for the purpose of giving passengers facilities for reaching the railway station or their destination after travelling as passengers on the railway, and that the competition of the municipal ferry served by the municipal tramways converging at the landing and embarking stations of the ferry, made it essential to the conduct of the railway business that the defendant company should afford such facilities for the use by the public of their railway under the Mersey competing with the ferry over the Mersey, and that the defendant company would prefer, if it were possible, which it was not, so to do, to carry by their motor-omnibus system exclusively those boarding or alighting at the stations of the defendant company. He could not persuade himself that the omnibus business was consequential on or incidental to the statutory powers of the defendant company in such sense as to bring it within their powers. He thought, however, that the Court ought, before confirming the injunction, to give the defendant company every facility for so modifying the mode of running their omnibus system as to bring it within their statutory powers. He thought, therefore, that they ought to postpone the confirmation of the order of Mr. Justice Warrington to enable the defendant company to modify their system, and to enable the Court so to arrange the terms of the injunction as to leave the company free to supply omnibus facilities for passengers going to and from their stations. The question of costs should be dealt with when they received from the railway company a statement of the conditions they thought they could take upon themselves for the continuance of their system.

Lord Justice Moulton said it could not be denied that the defendants' service worked in all essential respects as an ordinary omnibus service, and he suggested that the company should give an undertaking modifying their working, so as to limit it to the carriage of passengers on the railway.

Lord Justice Buckley thought that upon the defendants giving an undertaking that they were prepared to abandon the separate fares for persons travelling between points, neither of which was the central station, and that they would in future make all fares charged on the omnibuses fares to and from some one of their stations to the exclusion of fares to and from places, neither one of which was such a station, the injunction granted below should be discharged.

After some discussion, it was arranged that the question of the undertaking to be given by the company and the question of costs should be mentioned on Wednesday.

Electrical Patent Action.

The matter of Mr. S. J. Brown's Patent, No. 1,434 of 1889, came before Lords Justices Moulton and Buckley in the Appeal Court on the 7th inst. The patent relates to improvements in electric telegraph apparatus and to means for eliminating a varying zero in the recording instruments and for obtaining a better definition of the signals than before.

The action was one for revocation of the letters patent on the petition of Dr. Muirhead, who alleged that electro-magnetic shunts and induction coils with open and closed circuits had been sold and manufactured for years prior to the date of the patent and were in general use. The respondent wished to obtain information as to the real nature of the things to be alleged against them, and applied for further particulars. The Court of Appeal had held that certain particulars had to be given under the statute, but refused the application for further particulars. The respondent then applied for leave to administer interrogatories, and now appealed against Mr. Justice Neville's refusal.

Mr. Bousfield, K.C., who appeared with Mr. Graham, K.C., for the respondent, said the substance of the interrogatories was whether the anticipations alleged were in existence; if so, whether they could be seen, and if not, whether the petitioner would kindly say what they were. What they wanted to know was the proportions of self-induction and resistance.

Mr. Walter, K.C. (for the petitioner), said he was perfectly willing to give inspection of anything he had, but the interrogatories involved the construction of the specification, and related to the petitioner's case.

Lord Justice Moulton said the respondent had no right to ask the other side to give their conclusion on the evidence they had. Mr. Walter had offered as much as they could reasonably expect.

The appeal was dismissed.

LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names may be made. Answers are furnished by a barrister-at-law.*]

*** With reference to a query (No. 60) relating to the provision of fuses by undertakers, which was published in this column in the Electrical Review for November 23rd, the opinion was expressed that there is not, so far as can be ascertained, any special provision in the schedule to the Electric Lighting Clauses Act, 1899, relating to the provision of main fuses. This was advanced in answer to the question whether a corporation is within its legal rights in charging customers for a main fuse which is the only one between their mains and their meter. A correspondent has since pointed out that this matter is dealt with in the Board of Trade Regulations under the Electric Lighting Acts, 1882 and 1888, *r.* 38 of which provides that a suitable safety fuse or other automatic disconnector shall be inserted in each service line within a consumer's premises as close as possible to the point of entry, and contained within a suitable locker or sealed receptacle of fireproof construction, except in cases where the service line is protected by fuses in a street box. This clearly implies that the fuse in question must be provided by the corporation.

No. 61.—*Private Supply of Electricity—Whether Provisional Order Necessary.*

"Glasgow" writes: "Can you inform me whether it is competent for a private company or person to generate and supply electricity to the inhabitants of a town without obtaining Parliamentary powers?"

*** There is nothing to prevent any private company or person undertaking the supply of electricity. The Electric Lighting Acts

are enabling only, that is to say, while they confer privileges upon persons who supply electricity in accordance with a provisional order, they do not prevent private persons from undertaking any such enterprise. At the same time "Glasgow" may have some difficulty in procuring the necessary consents from the local authority to lay mains under streets, though they can be carried overhead without such consents. Further, he should take care to comply with the Board of Trade regulations which are specially directed to private undertakings. These regulations are set out in Shiress Will's "Law of Electric Lighting," Second Edition, p. 82, or they may be obtained *sub. tit* ; "Regulations Prescribed by the Board of Trade under Sec. 4 of the Electric Lighting Act, 1888," from Messrs. Eyre & Spottiswoode, London, E.C.

CORRESPONDENCE.

Letters received by us after* 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electricity Supply on the Rand.

Much attention is at present being drawn to a scheme to supply the Witwatersrand gold mines with electric power generated at the Victoria Falls. As I have had occasion to investigate this matter on behalf of the Rand Central Electric Works, Ltd., and as the matter is one having considerable public importance, I should like to communicate to you some of the conclusions at which I have arrived, and the directors of the works have authorised me to do this.

First, as to the amount of power which is required in the Rand. The total horse-power in the mines on the Rand is officially given as about 230,000. Of this, however, about half is used in mines whose probable life does not exceed 15 years, and may, therefore, be left out of account. Of the remainder about 25 per cent. is used at present in the form of compressed air at the faces, where it is unlikely that the electric will supersede the pneumatic system ; of what is left something like 12,000 H.P. is already electrical, so that the total possible future market in the Rand, so far as can be seen, is about 75,000 H.P. Considering the large capital expenditure required for electrification and the varying views of mining engineers as to the extent to which it is feasible to use electricity in the mines, it will be seen that a total of 50,000 H.P. represents a somewhat sanguine estimate, and that the preliminary amount of 20,000 H.P. now being spoken of as a small first instalment really represents a fairly large proportion of the possible demand.

The Victoria Falls scheme is to start with the erection on the Rand of an ordinary steam station on modern lines, containing about 20,000 H.P. in boilers, steam turbines and dynamos. This, of course, would be in itself a reasonable and proper scheme if it were not to be grossly over-capitalised. But although it may be shrewdly suspected that this station, if it were ever constructed, would be the end as well as the beginning of the enterprise, I am bound to assume, at least on paper, that the scheme for which the public is to find money is something enormously greater.

First of all, then, comes an ordinary 20,000-H.P. steam station. Next a huge low-level reservoir with electrically-driven pumps to utilise a part of the power coming from the Falls for pumping water into a second reservoir 600 ft. above the first. Then pipe lines coming down again connected to separate turbine-driven electrical plant again of 20,000 H.P., so that at this stage we have 40,000 H.P. of dynamos, 20,000 H.P. of steam plant, and the same of turbines and 6,000 H.P. (more or less) of electric motors and pumps, two reservoirs each of about 20 million gallons capacity with their dams, &c., and two high-pressure pipe lines, all for a gross delivery of 20,000 H.P. to the mines.

The reservoirs are to be large enough to contain water for driving the 20,000-H.P. turbine plant for 12 hours continuously, in case of a breakdown. This hydraulic arrangement, according to Mr. Wright, "enables an interruption of more than 12 hours of the transmission line to occur before the steam reserve station need actually be put to work," so that it "renders unnecessary the very heavy cost of keeping the reserve station always under steam throughout the year." Further, Mr. Wilson Fox says that the erection of a steam reserve station on the Rand "is a *sine qua non* demand on the part of the mine-owners," at which I am not at all surprised.

Then, in addition to the plant which I have mentioned, the complete scheme provides that each 20,000 H.P. at the Rand must have (*a*) about 30,000 H.P. of turbines, dynamos and transformers at the Falls ; (*b*) 700 miles of high tension transmission ; and (*c*) 20,000 H.P. of transformers, &c., at the Rand. It strikes one as rather "a large order" to have to provide about 70,000 H.P. of dynamos alone, and 50,000 H.P. of turbines, not to mention the 700 miles of transmission line, the steam engines, reservoirs, pumps, pipe lines and so on, for the sake of 20,000 H.P. on the Rand itself.

And it must be noticed that this is not only just at the start, for if Mr. Wilson Fox's statement which I have quoted above is correct, the power of the steam station, the power of the turbine plant and the 12-hour capacity of the reservoirs must always be kept equal to the capacity of the transmission from the Falls. When the latter, therefore, comes to 50,000 H.P., there must be a 50,000 H.P. steam station, reservoirs to supply 50,000 H.P. for 12 hours, a turbine-driven plant also of 50,000 H.P., and so on ! I can hardly imagine that the effect of this triple system upon the capital cost, and therefore upon the capital charges, has been seriously considered by the promoters, but I trust the public will consider it very seriously indeed.

As a matter of comparison, and as showing what the real financial magnitude of the business is on a proper commercial scale, it is interesting to notice how the Rand Central Electric Works, who are *not* asking the public for any capital, are situated, now that they are extending their plant on modern lines with the intention of supplying cheap power on a large scale. They possess an excellent site near the coalfields, where they are now obtaining coal under 10s. a ton. They have a 12,000-volt transmission line already erected along the Rand, they have long ago obtained full power to supply the mines wherever current is required, and they also have acquired the right to put up a new transmission line along the Rand, at 50,000 volts, for power purposes. The total cost of extending the Rand Co.'s present plant by an amount of 20,000 H.P. and putting down the corresponding transmission lines along the Rand is estimated at under £400,000, and tenders for the first section of the plant are at present under consideration. The total cost of this plant will therefore be about £20 per horse-power, and the whole capital charges upon it, allowing for interest at 6 per cent. and for ample depreciation, will not exceed 0·15d. per unit sold to the mines.

The total cost of the Victoria Falls Power Co.'s complete triple system cannot be less than £100 per horse-power. The capital charges alone on this will amount to about 0·80d. per unit. As power must be sold for something under 1d. per unit, it is obvious that practically the whole price is swallowed up in capital charges before anything whatever is put down for working, maintenance and management, including the "proper patrolling" of 700 miles of veldt, and the "sufficient number of breakdown gangs." Besides all this, I understand that £1,000,000 in ordinary shares is to be paid for the Victoria Falls concession. As the interest on this sum at 5 per cent. would much more than pay for the whole of the feed water for 50,000 H.P. at a steam station at the Rand price of 3s. per 1,000 gallons, it is also not easy to see where the boasted saving in this item, at any rate, comes in.

I do not wish to take up your space with any discussion of technical details, although on such points there is much to be said which differs from the statements which have lately been going the round of the papers. But I write this in the hope that an engineer's view of the hopeless finance of the scheme, apart altogether from its special engineering difficulties and possibly fallacies, may, perhaps, prove a useful counteractive to the fascination which anything sufficiently big and sufficiently distant seems to exercise on the public.

I hope that some day the enormous energy available from the Victoria Falls may be fully utilised (no doubt in the neighbourhood of the Falls, as with Niagara) to the great advantage of the world in general, and of South Africa in

particular. But I am very sure that the present scheme is not one which can ever yield any profitable return.

Alexander B. W. Kennedy.

Westminster, *December 11th*, 1906.

Wireless Telegraphy.

"Your Correspondent" is a good example of the law of compensation in nature. His instinct of self-preservation is evidently developed in proportion to his needs. Realising his deficiencies he preserves his anonymity—a wise course for anyone who, when his misstatements have been exposed, has not the moral courage to admit his errors, but can only evade the issues and make further misstatements.

There is no inconsistency between the position I took in my letter on November 27th, and that which I have taken at other time in relation to the matters with which it dealt.

"Your Correspondent" appears to imagine that it is practicable to give a correct interpretation of a provision of an agreement by quoting a sentence from it. Not only any lawyer, but any man of affairs, is aware that the position under a legal agreement is not disclosed by quoting a few words from it, and that it requires to be read as a whole.

The Post Office Department has been informed by the company that in the opinion of its legal advisers its agreement with the Post Office does not bear the interpretation which "Your Correspondent" put upon it. The company's experience entitles it to attach greater weight to this opinion than to that of the lawyer of so ill-instructed a client as "Your Correspondent."

I made no complaints in the Conference: I criticised the provisions of the Convention; showed that the policy pursued by the Marconi Companies was in accordance with precedent and usage in all public telegraph services and analogous public services of any kind; that it was a fallacy to assume that the refusal of the Marconi Companies to intercommunicate was contrary to usage and precedent; that the Convention provides for a service based on principles upon which no highly specialised public service is worked—viz., common use by competitors of apparatus, the use of which is the subject of competition; that the stipulations made by the chief Admiralty delegate at the beginning of the Conference had not been complied with; and that the arguments of the Post Office delegate in favour of exempting well-organised stations from the obligation to intercommunicate, if carried to their logical conclusion, were also arguments against the principle of intercommunication upon which the Convention is based.

To these criticisms, neither in the Conference nor to the company have the British delegates been able to make good any reply, nor has anyone else ever made good any reply.

I am aware of the instructions given to the British delegates. In my opinion, they did not carry them out. The British delegates did not carry every point they deemed vital, if they deemed any points vital which they urged at length. Only on one occasion did the British delegates succeed in carrying a vote against Germany. There were a number of arrangements advocated at length by the British delegates which they did not procure a majority of the Powers to adopt. They asked, *inter alia*, that:—

(*a*) Each State should reserve to itself the right to exempt certain stations from the obligation to exchange messages with ships fitted with apparatus of any system.

(*b*) An extra rate should be paid for messages to coast stations from ships equipped with apparatus of a system differing from that employed at the coast stations.

(*c*) Six British Colonies should have the right to one vote each at the next Conference.

(*d*) Intercommunication between ships carrying different systems should not be enforced.

(*e*) Suitable regulations should be devised for preventing interference and disturbance, and means should be adopted for enforcing these regulations.

On (*b*) (*c*) and (*d*) they were definitely outvoted, and in response to (*a*) the German Government carried a declaration signed by the majority of the Powers declaring that they would not exempt stations.

The proposal (*e*) clearly pointed to centralised control—the only means by which in a service of this kind regulations can be enforced. The Convention provides for a service based on the principle of decentralisation of division of authority among a number of competitors.

Does any sane man imagine that regulations preventing interference and confusion, can be satisfactorily enforced on a number of competitors who make common use of certain apparatus under such conditions that no one can get any value out of it unless some of the competitors forego from time to time, for the benefit of another of them, the use of the apparatus?

It is not correct that as representative of Montenegro I had no vote in the Conference. Each State represented had one vote; and for voting purposes these votes had exactly the same value. For example, the votes of Montenegro and Monaco together outweighed the British vote in the proportion of two to one. The British delegates were constantly outvoted in the Conference by Germany, aided by a number of minor States.

The statement made by me in my letter of November 27th with regard to the Admiralty contract—that it is not correct to say that "the Admiralty is not compelled to purchase any more apparatus from the Marconi Co., except jiggers and trays of Leyden jars"—is no mere verbal quibble, but a fact; and if "Your Correspondent" refers to the Admiralty on the subject, and the department thinks it worth while to give him the information, he will find that I am correct; and no one is in a position to substantiate a denial of my statement, or the correctness of "Your Correspondent's."

Marconi's Wireless Telegraph Co., Ltd.
H. Cuthbert Hall, *Managing Director.*

London, *December 11th*, 1906.

Inventors and Common Sense.

The interesting letter of "Convalescent," arising out of the braking correspondence, leads me to send you the following few thoughts on the above subject. The term "inventor" is a very elastic one and covers a wide area. The average engineer generally fights shy of the term "inventor." It brings before his mind visions of a very persistent and insistent type of individual who generally wants you to undertake the manufacture of something or other in which there is the usual "mint of money." Inventions have become a very important part of our engineering world. There are something like 25,000 patents, good, bad and indifferent, chiefly the last two classes, taken out in Great Britain per annum.

A good share of these are stillborn, and never reach adolescence, otherwise the complete specification stage. Again and again we see the words Abandoned, Abandoned, and many a weary story could be told before these words are uttered officially.

It is mere tautology to give the inventor's opinion of himself. Clearly, then, let us recognise the main conditions for the success of an "invention":—

1. A really good and clear idea.
2. A large amount of study, sacrifice, common sense and "donkey work."
3. A sympathetic capitalist manufacturer, if the inventor has but little capital. The following may be useful, although they partake of the nature of cold water.
4. Don't expect a manufacturer to throw aside his present methods of manufacture because a complete stranger, of whose competency he knows little or nothing, says, "There is something infinitely better than yours."
5. Don't expect any manufacturer or capitalist to rush at you with open arms, however good your invention may be. Caution and solidity are more the order of the day.
6. Don't be technical for the sake of being technical. Because you are an electrical engineer don't devise complicated electrical means, when a simple manual operation is all that is wanted, and can be easily done.
7. Remember that the manufacturer often stands to lose more, far more, than you do in the event of non-success.
8. An inventor, *per se*, is often of less use than a competent workman.

9. Use common sense—anent common sense, the following I hasten to say is pure fiction. The other night the shade of Robert Louis Stevenson visited me, and our conversation, telepathic, was on common sense. This is the story he told me, in his own simple, pure style. Upon a time, a sailor friend of mine returning from a voyage to the Island of Falesá, brought back with him a peculiar little wooden image, which at great pains he had got from an old native headman, who wept sore to part with it. Being an ordinary man and getting a bit sick of seeing the thing always knocking about under his nose, he made good to chop the thing up, and was about to squarely settle it altogether when something took him off it. Shortly after he gave it to me and went off to sea. In less than twelve months he met Davy Jones face to face. Well, I put the thing away in a cupboard, and straight forgot it, until one night I went to the cupboard, and there the little chap was blinking at me, wanting to say something pretty bad, and couldn't find how. It knocked me in a heap for a time, till I got breath. He was a rum looking little fellow with great staring eyes, and bushy eyebrows. His top lip was drawn and showed his yellow fangs. His bottom jaw stuck out like a vessel's bowsprit. But what hit me most was the great square forehead, and on nights when the moon was full, an old scar in the middle would gleam, and look wonderfully like an ill-scrawled "Com-sen," on which I thought much, but being only a trader, fell short like the fool I am.

His feet, too, had long toe-nails, which hurt fearfully when he lashed out, at being displeased, which he often was. After a time I got to like his old figurehead; for he meant me no ill, and his advice was always sound.

I got in the way of asking him about most of my schemes, and many a time he has thrown them in my face and kicked me. His kicks, my God! they did hurt.

I was like to fall foul of him above once, and once I made fit to do without his advice, but I came home like a beaten puppy. So that I—but here I am, babbling away like a kid—and the time's gone.

Alfred V. Newell.

Manchester, *December 10th*, 1906.

Commutator Lubrication.

With reference to the above, I am very much of the same opinion as "Electra." I have experienced some trouble in finding a suitable lubricant for small generators of from 100 KW. to 300 KW. For generators of about 100 KW., benzoline acts very well as a lubricant, at the same time keeps the commutator fairly clean. For generators of 300 KW., I have used plain paraffin for more than two years and find it answers admirably, though occasionally it should be wiped off as soon as put on to clean the commutator, or there will be a series of sparks, owing to the paraffin clearing the carbon dust from under the brushes. Paraffin wax generally collects at the bottom of the brushes, and when mixed with dust (plenty of which is flying about as a rule), sparking ensues, through its tendency to set up an insulation resistance.

T. J. B.

December 10th, 1906.

Rail Corrugation.

I feel confident that the discussion on corrugation of rails is taking a practical course when the cause is attributed to the rolling. Ever since this theory was introduced, I think by Mr. E. Kilburn Scott a year or two back, I have felt satisfied in my mind that he had solved the source of our troubles. I cannot quote Mr. Scott's exact words, but he put it down to the irregular passage of rails through the mills driven by antiquated steam engines, giving anything but a regular turning movement. Mr. Yerbury points out that too much play in the pinions and bearings of the rolls leaves a series of corrugations, called "teeth marks," upon the unfinished rails. In the smoothing down of them a wavy fibre is certain to be formed, and a varying hardness of metal throughout the length of rail. This wavy condition may be attributable to a collection of causes, among which the two above-mentioned are the principal.

Perhaps in addition to these, an irregular movement of a rail through the rolls might give a varying temperature to the bulge of metal thrown out on the rail in front of the rolls, hence a varying density and hardness, as it is forced down, of a wavy nature varying with the depth to which the metal is affected by pressure. These waves would most probably coincide or synchronise with the "teeth marks" spoken of by Mr. Yerbury, and thereby add to the unequal hardness, which would have a consequent effect upon the wear of rails. If this be the true cause of rail corrugation, I concur in Messrs. Bowker's and Yerbury's contentions—that prolonged rolling at low temperatures and annealing would lead to an improvement in rails, but think the rolling process should be carried out last of all, in order to leave a finished tread free from irregularities liable to occur in the annealing.

I think, however, that the first step in the direction of improving the condition of rails is for rolling mill engineers to provide better driving gear. An electric drive, for instance—which many may by now have applied—and something to take the place of the roll pinions, whereby a perfectly steady motion is obtainable, would apparently be just as necessary.

I may say that I have had experience of corrugations upon rails with concrete foundations, also upon those having cross-sleeper construction, and have little faith in the theory that foundations affect the rails in this respect.

I have seen a worn piece of rail with the upper part of the tread ripped off, the surfaces of which had a wavy appearance, but cannot say if it had a corrugated tread. I have observed rails manufactured over ten years ago which had better wearing qualities all round than some turned out more than five years later.

H. Thom,

Late General Manager, Madras Tramways.

Southampton, *December 10th*, 1906.

A Plea for the Hectomegaline.

I have consulted many works on the theory of the dynamo, and in all of them I find the flux measured in C.G.S. units (*lines*), while the electromotive force is measured in *volts*. Thus, if F represents the flux, S the number of conductors in series and X the number of times each conductor crosses the flux per second, the equation

$$E \text{ (average)} = F S X$$

is true in the C.G.S. system, but not in the system of the text-books. Yet care has been taken so to arrange matters that other equations—such as $C = E/R$—shall be true in both systems.

I would suggest that some well-known writer, in his next edition, should remove this anomaly by adopting as his unit of flux the *hectomegaline*. Perhaps he will consider this word too long, and prefer to give the unit a shorter name, derived from that of some distinguished electrician (I hope, however, that he will not call it a Kapp or a Hop; we give the punsters quite enough chances already).

W. F. Dunton.

London, *December 7th*, 1906.

Tramcar Brakes.

In connection with the suggestion of your correspondent "Brakite," that the compressed air brake is the best type of brake for tramcars, it is interesting to note that double-truck cars, equipped with such a brake system, actually take less current for their operation than if they were fitted with hand brakes only, notwithstanding the fact that the air compressor motor has to be driven. Tests made on cars equipped with the Christensen air-brake apparatus, which is a system that has been specially developed for electric railway and tramcars, and is in use on the great majority of electric cars using air brakes, show an economy in total current consumption of 10 to 15 per cent. The reason for this economy is a simple one; it arises owing to the fact that the air brake can be applied so rapidly that the driver always leaves it in the off position, except when he actually needs it, so that the brake shoes are kept clear of the wheels, whereas with the hand brake, especially in crowded traffic,

approaching curves or points, the driver usually keeps the brake blocks just riding on the wheels in order that he may bring the car under control as quickly as possible in case of necessity. Also, in starting, the hand brake is very often not fully released until the controller handle is in the second notch. Thus the extra current which would in the case of the hand brake system be required to overcome the friction of the brake blocks is saved, and it is found to be much greater than that required to operate the independent motor-driven air compressor.

Objection has been raised to the air brake on the count that if the trolley left the overhead wire it would be inoperative; this is not so, as a reservoir is always fitted, capable of supplying sufficient air for a large number of applications after the compressor had ceased to operate.

The air brake is a service and an emergency brake in one, since by a slight movement of the valve handle the brakes can be applied with any pressure desired. The brake rigging is usually designed, so that it is nearly impossible to cause the wheels to lock; should the wheels lock owing to the bad condition of the rails or other accidental cause, the brake can instantly be released and applied again as soon as they start revolving, for, as is well known, the braking effect through a revolving wheel is greater than with a locked wheel.

R. Borlase Matthews.

Swansea, *December 8th*, 1906.

Tungsten Lamps.

I should be much obliged if any of your correspondents could say from whom the Tungsten lamp, which is reported to have an efficiency of 1 c.p. per watt, can be obtained. I do not refer to the Osram lamp which I have heard some people refer to as the Tungsten lamp. The lamp I refer to is not yet on the British market, but, I believe, is obtainable in Germany.

Efficiency.

The Conduit Trust.

Although the above combination, association, working arrangement, trust, or whatever else it may be called, has now been in operation since November 1st, not a word of protest appears to have been raised against it, although I fully expected a general cry from the contractors denouncing the same, and especially in view of what has transpired during the last few weeks.

Is it possible that contractors' profits are so large at the present time that they can afford to pay "trust" firms 20 per cent. more for their conduits than the same can be obtained for, from "non-trust" firms, or is it that they are anxious to pay the enhanced prices without a murmur and be dictated to by a ring of manufacturers to enable the latter to increase their profits at the expense of the contractor, or is the contractor going to buy from those firms that are still willing to sell a good article at a moderate price?

Surely the expenses of production are not 20 per cent. greater with "twelve of the largest manufacturers" than the others that are in the field, if so, why?

The only information that has been forthcoming in the matter, is that from a certain date twelve firms will quote a common discount from a common price list. Are these "twelve firms" going to reduce advertising, travellers' and other expenses, and pool the increased profits?

Perhaps some member of the conduit "trust" will be good enough to enlighten the trade on the subject, so that should its intentions be honourable to the contractor, it may merit a continuance of his patronage without leaving him in a field of doubt.

Contractor.

December 4th, 1906.

Engineering Apprenticeship.

In your issue of December 7th, Mr. W. Mayall Milnes contributes an article on the training of shift engineers. Can you, or Mr. Milnes, advise whether a would-be engineer should pay a premium for his mechanical apprenticeship or not? It seems impossible to enter an engineering works without influence, experience or money.

A Young Hopeful.

[We print this letter as a sample of a class which continually reaches us. The apprenticeship problem is a very important and serious matter, and we shall be glad of our readers' comments.—Eds. E.R.

Wiring Estimates.

Referring to the correspondence on the subject of "Wiring Estimates" in your current issue, we would respectfully draw your attention to the form given at the end of the "Practical Electrician's Pocket-Book and Diary," of which we enclose a copy herewith. We have found that these are appreciated by electrical contractors all over the kingdom, and might, perhaps, meet the requirements of your correspondent.

The Publishers of the Book.

The Social Side of the I.E.E.

Perhaps the feature of the annual dinner of the I.E.E. that is appreciated most of all, is the opportunity given the members, more especially before and after the dinner, to meet together to renew old acquaintanceships, to make new ones, and to chat about matters of mutual interest. Many would be glad of more frequent opportunities of this kind, and the object of this letter is to make the suggestion that, following the precedent of the American I.E.E., an arrangement be afforded whereby the members who so desired could gather and dine together in an informal way on the evenings of the ordinary general meetings, at a restaurant in the neighbourhood of the place of meeting.

The American I.E.E. have an arrangement with a restaurant whereby reception and dining rooms are placed at their disposal on the nights their meetings are held, for which no charge is made, and no notice is given to the restaurant management as to how many propose dining, this making it much more convenient to those who may wish to attend, as they have not to give any notice of their intention, and if delayed and unable to come, it does not make any difference. A notice of this informal dinner is given on the postcards which announce the date of each meeting and the subject of the paper to be read. Evening dress is not worn at these informal dinners, as they are intended to suit the convenience of those who have come direct from their business, and in New York, as in London, most men live at some considerable distance from their places of business, which usually necessitates their dining in the City somewhere if they wish to get to the evening meeting in good time.

R. B. M.

[It is due to our correspondent to state that the suggestion embodied in our leaderette on this subject last week was based on information derived from him; his letter, which was written before he saw the leaderette, contains further particulars, and we hope the matter may be followed up. As many are aware, it used to be customary for members of the I.E.E. to sup together *after* the meetings; but this practice has fallen into disuse, and in view of the lateness of the hour of adjournment, as well as of the long interval prior to the commencement of the meetings, it would seem preferable to dine. The suggestion is, of course, applicable to many of the Local Sections as well as to the London meetings. —Eds. E.R.]

A Monument to Faraday.

The report of the unveiling of the Metal Tablet Memorial to Faraday at the Barnsbury Meeting House of the Sandemanians, reminds me of an incident that illustrates the prevalent ignorance amongst the people at large of the work done by Faraday. Even the street arabs of Glasgow remember the name of James Watt, although according to *Punch*, they give him the credit for *inventing steam*, at least this is my recollection of Glasgow 25 years ago.

Whilst travelling quite recently on the Metropolitan Electrified District Railway, I had, as a fellow passenger, a fine example of a yeoman farmer, a class that is, alas, being rapidly reduced in numbers; he said he had come to London from Settle, in Yorkshire, for the first time in his life, and had secured the first prize for his exhibit of sheep dogs—he was, nevertheless, a man of shrewd intelligence. I asked him what had impressed him more than anything else during his visit to the Metropolis; he replied, "this train," and further exclaimed "t' man who had made it possible to run a train without a locomotive, and by electricity, was surely, and, 'by gum,' the greatest man in t' history of the world."

I asked him whether he had ever heard or known of a family bearing the name of Faraday, and living in the district of Settle or Clapham, Yorkshire. "Aye," he said, "years ago I knew a farmer called Faraday, and there were several of that name in the neighbourhood, but most of them have passed away." I told him that both the father and the mother of the man who had made it possible to run trains electrically were fellow-dalesmen of his, as they were bred and born near Settle. The farmer looked incredulous, but I eventually convinced him of the truth of what I said, and he could not have looked prouder had he been a near relative of the illustrious Faraday himself; he said, "I shall astonish the natives when I get home."

But can we wonder that Faraday's name is unknown to the man in the street or in the lane? There is no outward reminder to the foreigner or to the provincial that Faraday, although of Yorkshire stock, was born and accomplished his life-work in London.

Certainly there is the beautiful statue in the Royal Institution, but there is no fitting external monument, nor is there any great avenue or street bearing his name, and proving that London recognises the value of the work of one of its greatest citizens, the results of whose work are destined to be so far-reaching and beneficial to the human race.

May we not ask, Sir, whether the time has not arrived when all the London technical institutions—Civil Engineering, Mechanical, Chemical and Electrical—should combine to rear a monument in London Town that will be really worthy of the immeasurable grandeur of Michael Faraday's work and character?

B. H. Thwaite.

London, S.W., *December 7th*, 1906.

Advertising in Electricity Works Pamphlets.

With reference to the insertion of advertisements in electricity undertaking bulletins, &c., by the various electrical manufacturers and others interested in the industry, might I be allowed to ask how these said manufacturers can expect to receive plenty of orders for their products unless the various electricity undertakings are getting a goodly number of new customers? And can anyone claim that there is a better way of popularising the use of electricity than advertising its advantages amongst the possible consumers thereof?

C. Rockley.

West Ham Corporation Electricity Supply
Publicity Department,
December 4th, 1906.

The formation of a society of Publicity Managers, as proposed by "Publicity Department Manager," is a very excellent scheme, and, I am sure, will receive the hearty support of all interested in this class of work. It would seem, however, that your correspondent wishes to confine the society to representatives of electrical firms only. I think that the membership should be extended to representatives of general engineering firms, as the number of publicity managers of electrical firms would be too small to make the success of the society assured.

While I agree with your correspondent "Electricity Supply," whose letter appeared in the last issue of your journal, that representatives of electrical supply undertakings should be included in the society, I do not think that it should be extended to "canvassers and other qualified assistants," as he proposes. I hope that, through your good offices, it will be possible to form a committee at an early date, who will be able to discuss these matters thoroughly, and settle in a general way the rules for the guidance of the society.

P.D M.

Nernst Lamp Renewals.

I have been following with some interest the controversy in these columns with reference to Nernst lamp burners, and I think a few facts concerning my own experience with these lamps may prove worthy of reading. I have under my charge 77 "A" type 1-ampere lamps, and 97 "A" type ½-ampere lamps, also a few dozen "B" type ¼-ampere lamps. These are used for illuminating the various rooms of a large factory. The maintenance and renewals costs per lamp, including burners, resistances and magnets during the last two years result as follows:—

Year.	1-amp. "A" type.	½-amp. "A" type.	¼-amp. "B" type.
1905.	10s. 4d. (81)	5s. 11d. (78)	2s. 3½d. (42)
1906 to Nov. 30th	7s. 5d. (77)	4s. 3d. (97)	2s. 4½d. (34)

Bracketed figures give number of lamps used.

During 1905 I experimented with the "Luna" flat type brilliant burner, but the results were not nearly so satisfactory, because, although the downward light so obtained was very much better, yet the life of the burner was considerably less than that of the "A" type burner; add to this the fact that the initial cost of the flat burner is higher than that of the "A" type, and it will be understood why the costs for renewals during 1905 were so high. I ultimately entirely dispensed with the use of flat burners. With regard to the life of burners, in my particular case the average life, as near as such can be determined with indoor working, of the 1-ampere "A" type burner is over 300 hours; and of the ½-ampere "A" type burner, over 350 hours; these figures, of course, do not include defective burners, which we are able to exchange for good ones. I find that the chief causes of burners failing are vibration and faulty magnets. The former I practically entirely eliminated by suspending all lamps on a delicate spring at the end of a brass wire, which simple device also served to take the weight of the lamp off the flexible. In regard to faulty magnets, I found it necessary to test the lamp carefully in order to determine exactly what happened when the magnet failed to act. The figures obtained may prove interesting:—

Type.	Current consumed.	Remarks.
1-ampere "A"	0·38 ampere	Heater coil only.
	0·96 "	Glower only, cut-out acting.
	1·32 "	Cut-out fails to act.
½-ampere "A"	0·30 "	Heater coil only.
	0 54 "	Glower only, cut-out acts.
	0 86 "	Cut-out fails to act.

In the first case, the increase of consumption due to faulty magnet is 37 per cent., and in the latter case, 60 per cent.

It is quite conceivable that the result of both heater and glower being on at the same time, is greatly to increase the heat emitted by the burner, and it would be interesting to know exactly what effect this increase has on either the heater or the glower; as I find that if a lamp after burning about half an hour, under such circumstances, is switched off and then on again, the heater fails to conduct current, although to all outward appearance the burner is perfect. The common causes for magnets failing are:—too strong a spring, and burnt-out coil. The trouble with the spring is easily got over by using on it a penknife; the remedy for a burnt-out coil is obvious. I find that magnet coils last about 2,000 burning hours, and resistances a trifle longer.

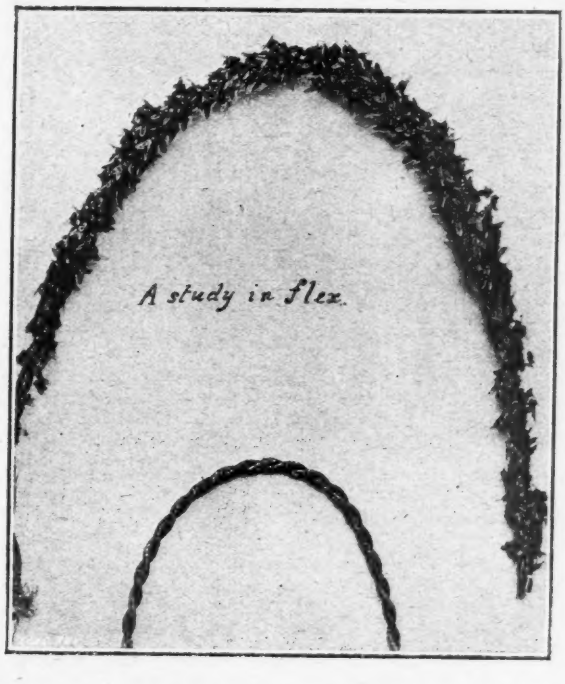
In conclusion, the figures given above are not specially cooked for the purpose, but are deduced from careful records, which I made a point of keeping from the very commencement of using the lamps, and I give them as a reply to the engineer, at Stirling, who in your issue of the 24th ult. made such damaging and unwarrantable remarks concerning the 1-ampere "A" type lamps. Probably if this engineer had taken the trouble to go carefully into the causes of, and possible remedies for, the troubles he complains of, he would not have found it necessary to run down one of the best modern competitors of gas lighting. I am sure that

there are others who can corroborate my statements. Obviously, it is to the interest of electric lighting for those personally concerned to do their best to improve, or to make easy, the introduction of any new form of electric lamp devised, and not to give gas people an opportunity of using their published complaints against them when in the field for new consumers.

P. A. S.

A Study in Flex.

Here is a little Natural History study in the shape of a photograph of the sort of thing they have to contend with in Australia in the summer season. The snapshot was taken by Mr. F. W. Clements, Melbourne, and he tells me that



the burning through of flexible wire is a continual trouble in Australia, in consequence of the excreta of the flies containing ammonia, which dissolves away the rubber!

W. E. Lane.

London, E.C., *December 10th*, 1906.

Inquiry.—A correspondent wishes to be put in communication with a firm that can wind small bobbins with very fine wire.

THE VEREENIGING POWER SCHEME.

We have received the following communication from Messrs. Lewis and Marks:—

As so much attention has been called to the proposed supply of electric power to the Rand from the Victoria Falls, we think that it may not be altogether out of place to point out that another and more practicable scheme exists, namely, the supply of power from the Vereeniging coalfields.

Vereeniging, situated on the Vaal river, lies about 35 miles south of Johannesburg, and is the centre of a considerable coalfield, the mines lying on both sides of the Vaal.

The river, which is a large one, has been dammed, and thus affords a plentiful supply of water at all seasons.

At Vereeniging it is intended to erect a station containing about 12,000 kw. of plant to begin with, leaving room for an additional 8,000 kw., thus providing for ample extension. There will be nothing extraordinary about this plant, which would be of standard three-phase construction and steam driven, the pressure being stepped up to about 35,000 volts for transmission purposes.

From Vereeniging three overhead lines would be carried, one to the centre of the Rand, one to the East, and one to the West Rand, all three being jointed together by a sub-station "inter-connector" following the line of the reef. Along the reef, at such places as would appear most advisable step-down transformer sub-stations would be provided, reducing the transmission pressure to a voltage suitable for use on the mines.

The country between Vereeniging and the Rand is open veldt with good roads, and is practically free of any obstruction, the only kopjes of any importance being in the Heidelberg district, over which the line to the East Rand would have to run. As these kopjes are already traversed by the trunk telegraph lines, there is no doubt that a transmission line can be run with perfect safety and small expense.

The inspection and repair would be quite easy, the whole route being negotiable on a motor-bicycle, and the length is so short that the cost of the three transmission lines is quite moderate, and with these three lines well and solidly constructed, the continuity of supply should be sufficiently guaranteed.

The transport of line material would present no difficulties, as the main railway line from Bloemfontein to Johannesburg passes through Vereeniging, so that one of the transmission lines would always be close to the railway, whilst neither of the other two would ever be more than 10 or 12 miles away from it.

From past experience in Europe and America, we know that, with so moderate a tension as 35,000 volts, no difficulties will arise in line construction; whilst in the event of a breakdown from gales or other causes, the location of the fault and the quick repair of the same could be carried out without difficulty.

Few people other than those conversant with the conditions prevailing on the Rand mines can conceive what an interruption of supply means. The gold-extracting plant, such as the mills, stamp batteries, and cyanide apparatus work continuously for seven days in the week, so that any interruption practically means a reduction in the annual gold output, consequently no scheme other than one as reliable as human intelligence can make it would ever be successful from a commercial point of view. Whilst at the same time the price of power would have to be sold at so small a margin of profit, that no scheme with excessive stand-by charges, such as are proposed in connection with the Victoria Falls, could ever be reasonably expected to pay a dividend.

The market for power can hardly be deduced from the annual report of the Government mining engineer, as a considerable proportion of the 238,822 h.p., mentioned as being installed, consists of winding and mill engines, which in the case of existing mines would never be scrapped wholesale by the mine owners. At the moment something like 25,500 h.p. in electric motors is in use on the mines, mostly in connection with pumping plant. Of this a considerable proportion is already supplied by good plant of modern design, running under excellent conditions. The only difficulty in connection with the stations is that their economical limit is very soon reached, due to the scarcity of water, which when bought from the Rand Water Board never costs less than about 3s. per 1,000 gallons. Consequently, when a generating station situated on a mine becomes of such size that the water supply owned by the the mine itself ceases to be sufficient for boiler feed, and ordinary mining purposes, it is more or less impossible to increase the capacity of the generating station, as the excessive charge for water very soon brings up the working costs to an unreasonable figure.

With these points in mind, one will not have any difficulty in arriving at a just conclusion as to which scheme would be most likely to pay in connection with the supply of electric power to the Rand mines, and at the present time, when most of the mines are already equipped, and a great many have reached the stage when their useful life is within measurable distance of ending, no one would suggest that anything like the amount of power that the various promoters look upon as forming a market for supply, is likely to be reached for a considerable number of years, unless a rapid development of new mines takes place, or a new reef is discovered.

BUSINESS NOTES.

Book Notices.—*Hazell's Annual for* 1907. Edited by W. Palmer, B.A. London: Hazell, Watson & Viney, Ltd. 3s. 6d. net.—Of this work it is almost sufficient to announce that the new edition has been published this week. For 22 years it has appeared annually, and for those who want at hand a summary of the events at home and abroad during the past extraordinarily full and interesting year it is extremely useful. There is a brief summary of electrical progress, which might be more correct, but may interest the general reader—we don't recommend the electrical man to buy the book for this section, but for its general usefulness as a brief record of a crowded year's happenings.

"Universal Dictionary of Mechanical Drawing." By George H. Follows. London: A. Constable & Co.; New York: *Engineering News* Publishing Co. 4s. net.

"Journal and Transactions of the Junior Institution of Engineers." Vol. XVI, 1905-6. London: Percival Marshall & Co. Price 10s. 6d.

"Report of the Board of Education for the Year 1905-6." London: The Secretary of the Board, or Wyman & Sons, Ltd. Price 5½d.

"Proceedings of the American Society of Civil Engineers." Vol. XXXII, No. 9, November, 1906. New York: The Society, 220, West 57th Street.

Boiler House Economy.—The following interesting particulars as to the result of boiler tests made at the Worcester Corporation Electricity Works have been placed at our disposal. The tests were made between hand-firing and the Bennis sprinkling stoker and compressed air furnace. The durations of the tests were 10, 9½ and 7¾ hours, respectively:—

System of firing	Hand.	Bennis stoker and compressed air furnace.	
Type of boiler	Babcock and Wilcox.	Babcock and Wilcox.	Babcock and Wilcox.
Name of coal	South Wales smokeless steam	Harley	Kingswood
Class of coal	Through.	Slack.	Smudge.
Calorific value of coal per lb. as fired	14,023 B.TH.U.	9,274 B.TH.U.	9,188 B.TH.U.
Price of coal per ton, delivered	15s. 6d.	7s. 6d.	5s. 9d.
Coal burnt per boiler per hour	1,094 lb.	1,792 lb.	1,994 lb.
Coal burnt per sq. ft. grate surface per hour	24·32 lb.	42·66 lb.	47·48 lb.
Equivalent evaporation per boiler per hour	11,875 lb.	12,144 lb.	10,963 lb.
Equivalent evaporation per sq. ft. heating surface per hour	4·164 lb.	4·258 lb.	3·844 lb.
Equivalent evaporation per lb. of coal	10·85 lb.	6·777 lb.	5·497 lb.
Total thermal efficiency obtained	74·76 %	70·59 %	57·79 %
Cost of fuel to evaporate 1,000 gals. of water, as from and at 212° F.	76·52d.	59·28d.	56·04d.
Reduction in fuel cost per 1,000 gals. evaporated	—	22·53 %	26·76 %

Date.—Tests completed October 1st, 1906.

Water evaporated.—With reference to the quantity of water evaporated in these tests, it was only necessary to keep sufficient steam to run the load. There was only one boiler under steam, hence any variation in the load would affect the quantity of water evaporated. The stoker was capable of giving considerably more team, had it been required.

Diaries.—From the Brush Co. comes the ever-welcome diary. Especially welcome is that for 1907, seeing that it is issued thus early.

Equally welcome is a very useful form of diary with which we have been favoured by Messrs. Thomas Bolton & Sons.

X Electric Accumulator.—We have received from the X Electric Accumulator Co., Ltd., of 19A, Carlyle Square, Chelsea, S.W., a sample of their smallest type of ignition cell, in which the positive plate is maintained in position between two negatives by short glass supports passing through the latter, thus dispensing with bottom blocks. The plates are separated by perforated insulators, similarly supported. The negatives are not pasted on the outer side, but are strengthened by diagonal ribs, whilst retaining lightness. The company also makes traction and launch batteries, the special features claimed for these being exceptional lightness, strength and durability, combined with high efficiency. The cells are of British manufacture throughout.

Glover's Contracts.—Messrs. W. T. Glover & Co., Ltd., Trafford Park, Manchester, have this week secured the following orders:—

Natal Harbour Board, South Africa.—7,160 yards Diatrine paper-insulated and lead-covered cable; 1,660 yards rubber-insulated lead-covered and braided cable and joint boxes; total value, £2,878.

Metropolitan Borough of Shoreditch.—1,100 yards Diatrine paper-insulated and lead-covered cable; value, £420.

Trade Announcements.—Mr. Trevor Duesbury, the engineer and manager of the Corporation of Sutton Coldfield Electricity Department, announces that on and after December 10th the retail lamps, fittings and repairs business of that department will be discontinued, and that arrangements have been concluded with Messrs. Clive & Co., electrical engineers, to carry it on as the Corporation's agents at their new showrooms, situated in High Street, Sutton Coldfield. They will carry a large stock of lamps, fittings and accessories. At the showroom the latest appliances for electric lighting, heating, cooking and motive power are on view in actual use.

Messrs. F. E. Emerson & Sons notify that owing to increased business they have entirely disposed of their old plant at Victoria Electrical Works, Burdett Road, Bow, and have taken new workshops at 7, Broken Wharf, Upper Thames Street, E.C., which have been fitted entirely with up-to-date plant and machinery. They will continue the manufacture as heretofore of brass pushes, contacts, burglar alarms, bell switches and every description of electrical brass work. They are also manufacturing bells, telephones, and many lines of switches, lamps, and all electrical accessories.

Messrs. Neville & Co., Mansion House Chambers, E.C., insulation specialists and manufacturers of the "Varsulat" registered series of insulating varnishes, have, owing to the increase in their business, removed to larger and more suitable premises at 11 and 13, Southwark Street, S.E. (telephone No. 3356 Hop). They will in future trade under the style of Neville, Williams & Co.

Messrs. D. M. Malloch & Co., of 50, Wellington Street, Glasgow, have been appointed sole agents for the Liverpool Electric Cable Co., Ltd., for Scotland.

Card Filing System.—Mr. G. Dunkerley, whose ingenious pocket system of filing cards with a novel filing clip was mentioned in our issue of 30th ult., informs us that his correct address is 18, Claremont Avenue, New Malden, Surrey, not the address previously given.

Maxim Arcs at Lord's.—The Squash Racquet Court at Lord's Cricket Ground has now been lighted by means of Maxim Arc Lamps to enable play to go on at all hours. The arrangements were satisfactorily effected by Mr. Charles Bright, F.R.S.E., M.I.E.E.

Catalogues and Lists.—The Adams Manufacturing Co., Ltd., London and Bedford.—A number of illustrated lists relating to their "Igranic" automatic motor-controlling rheostats, caught together in a red binder cover. Descriptive information, general and diagrammatic illustrations, also tables of prices, are given.

Messrs. Seabrook Bros., 32-34, Featherstone Street, E.C.—Eight-page circular illustrating and giving prices of their small "Kenco" battery motors, toy motors, midget dynamos and parts, battery fans, model electric tramways and railways, and other things that are acceptable to the rising generation as presents at Christmas time.

The General Electric Sign and Engineering Co., Ltd., 15, Dufferin Street, E.C.—Eight-page pamphlet giving particulars, illustrations and prices of the Ge-Se electric signs for inside and outside advertising purposes.

Messrs. H. A. Jackson & Co., Caxton Hall, Salford, Manchester.—Circular showing some good designs of hand-beaten art metal luminous radiators, and stating prices. Other lists from the same firm give prices of tantalum lamps, and cables and wires.

Messrs. Snowdon, Sons & Co., Ltd., Millwall, E.—Illustrated circular relating to "Sinol," a cylinder lubricant and lubricators, which are of special interest to central station engineers, as they are largely used in electric power stations where superheated steam is used.

The Chloride Electrical Storage Co., Ltd., Clifton Junction, Manchester.—Circular No. 16, containing an illustrated description of the Entz booster at the electricity works of the Greenock Corporation.

The Vortex Pulley and Belting Co., Tower Royal, E.C.—Price list of "B B" wood-split pulleys from 3 in. to 72 in. in diameter by 3 to 24 in. width of face.

Messrs. Elliott Bros., Lewisham, S.E.—Illustrated pamphlet (No. T.S. 96), describing the Harrison universal photometer; also pamphlet No. D.C. 95, relating to moving-coil instruments, and stating prices of the same.

Messrs. Siebe, Gorman & Co., Ltd., of 187, Westminster Bridge Road, S.E., send us their illustrated pamphlets relating to "Oxylithe," a new substance for producing chemically pure oxygen by simple contact with water, with perfect safety.

Dissolutions and Liquidations.—Phillips's Railway Signalling Syndicate, Ltd.—This company is winding up voluntarily with Mr. D. L. Chalmers, 12, St. John's Lane, Liverpool, as liquidator.

Carnarvonshire Electric Traction Syndicate, Ltd.—Creditors must send the usual particulars to the liquidator, Mr. F. B. Fuller, 13, St. Helen's Place, E.C., by January 7th.

Boiler Coverings, Ltd.—A meeting will be held at 51, North John Street, Liverpool, on January 9th, to hear an account of the winding-up from Mr. Sydney S. Dawson, the liquidator.

Auto-Electric Rifle and Target Co., Ltd.—A meeting is to be held on January 9th at 53A, Shaftesbury Avenue, W., to hear an account of the liquidation.

A. Watson & Co., electrical engineers and electrical accessory manufacturers, Edward Street, The Parade, Birmingham.—Messrs. W. J. Charles and A. Watson have dissolved partnership.

John D. Mackenzie & Co., electrical engineers, 30, Woodlands Road, Glasgow (and John Donald Mackenzie, the sole partner thereof), have granted a trust deed in favour of David Spalding, accountant, 11, West Regent Street, Glasgow. All parties having claims, &c., are requested to lodge the same by to-morrow.

Punjaub Electric Traction Co., Ltd.—Creditors must send particulars of their debts, &c., to Mr. F. B. Fuller, 13, St. Helen's Place, E.C., by January 8th.

Thames Valley Electric Supply Co., Ltd.—A meeting is to be held at Donington House, Norfolk Street, W.C., on January 14th, to hear an account of the winding-up from the liquidator (Mr. H. A. Stagg).

Bankruptcy Proceedings.—C. V. T. De Falbe, electrical engineer, Shaftesbury Avenue, London (Electrical and General Contracting Co.).—December 21st is the last day for receipt of proofs for intended dividend, by the trustee (Mr. E. H. Hawkins, 3, Barbican, E.C.).

Ernest Crompton Holt (Holt & Co.), electrical engineer, Queen's Arcade, Rhyl. Receiving order made December 6th, at Bangor, on debtor's petition.

E.C.C. Works Hospital Fund.—The annual meeting of the Hospital Fund Committee, connected with the Electric Construction Co., Ltd., Bushbury, near Wolverhampton, was held in the Institute of the works last week for the purpose of allocating the contributions of the employés to the various hospitals; £190 18s. 10d. had been realised.

British Standard Screw Threads.—We have received a copy of the tables of British standard screw threads issued by the Publication Committee of the Engineering Standards Committee; they can be had either in pamphlet form, gratis on receipt of 1d. stamp, or mounted on a large card and varnished, price 6d., post free 10d. The tables, three in number, cover British standard "Whitworth," "Fine," and "Pipe" threads, from ¼ in. to 6 in. diameter, in the case of the first two, and from ⅛ in. to 18 in. nominal bore for tubes. In each case full particulars of number of threads per inch, pitch, dimensions of thread and core, &c., are given. The tables are based on the reports Nos. 20 and 21 of the Committee.

For Sale.—The Marylebone Borough Council is inviting offers for the purchase of Parsons direct and alternating-current turbo-generators and feeder panels. Some particulars will be found among our "Official Notices" to-day.

LIGHTING and POWER NOTES.

Aspull.—The U.D.C. has appointed a committee to interview the Chairman of the Lancashire Electric Power Co. and ascertain upon what terms the company would take over the E.L. order and supply energy in bulk.

Australia.—Melbourne.—Owing to the incorporation of the northern suburbs with the city, and the increased demand from other quarters, the full capacity of the Corporation's electrical plant has been more than reached. Arrangements have consequently been made with the Electric Lighting and Traction Co., Ltd., for the supply of electricity south of the Yarra, the energy to cost 2½d. per unit at the city boundary. The difference between the sum mentioned and the 4½d. charged to consumers will reimburse the Council for the necessary expenses, including wiring and fittings.—*Australasian Hardware.*

Axwell Park Colliery.—Recently, 250 members of the North of England Institute of Mining and Mechanical Engineers journeyed from Newcastle-on-Tyne to Axwell Park Colliery by special train, for the purpose of inspecting the electric winding plant which the Priestman Collieries, Ltd., have lately installed there. All the hauling, pumping, ventilating, underground and surface winding, screening, disintegrating, elevating, &c., is now worked by electrically-driven machinery. The visitors included Mr. S. Corlett, of the Corlett Electrical Engineering Co., who were responsible for the work; and Mr. Clift, of Messrs. Siemens, who supplied the machinery. The visitors were entertained to luncheon by the proprietors, and Mr. Francis Priestman, replying to a vote of thanks, said the colliery was being worked very economically and well.

Bacup.—The T.C. is applying for a loan of £7,000 for electricity purposes.

Bath.—In regard to a recent offer to take over the Corporation electricity undertaking, made on behalf of a syndicate which has acquired the rights of the Somerset and District Electric Power Act and the Western Electric Distribution Corporation, a Committee has been formed to consider the matter and to ascertain the powers of the Council to transfer the undertaking.

Beaumaris.—Provided the interests of the town are safeguarded, the T.C. has decided to support the E.L. scheme for the districts of Menai Bridge and Llanfair submitted by Mr. J. W. Williams.

Beckenham.—On Monday last the U.D.C. passed a report from its Electricity Committee regarding the completion of the negotiations respecting the taking over of that part of the undertaking of the South Metropolitan E.L. and P. Co. which is within its area. It appeared that the price to be paid was equal to what had been spent on the portion concerned with an addition of 33⅓ per cent., but the original company failed, and the undertaking was taken over by the contractors, who sold it to another company, from whom the present vendors obtained it. A large number of the original books and documents had disappeared, and considerable difficulty arose. However, arbitration has been avoided, and as a result of negotiation the company's original claim has been reduced from £8,762 to £4,898. The Council decided to draw a cheque for this sum plus £289 for works executed since the original notice was served, and £611 for free wiring at original cost.

Burton-on-Trent.—A L.G.B. inquiry was held on December 4th, into the application of the T.C. for a loan of £4,000 for E.L. purposes. There was no opposition.

Bury (Lancs.).—The T.C. has applied to the L.G.B. for a loan of £22,500 for E.L. purposes.

Canada.—Ontario.—An Ottawa correspondent writes: With the development of the immense water powers of Ontario, now making rapid progress, for the generation of electrical energy, the country is destined to be the greatest field for electrical development, perhaps, in the world. The action of the Ontario Government in creating an electrical power commission with the primary object of supplying power to the various towns and cities at as near actual cost as possible, has given a great impetus to the utilisation of hydro-electric power in place of steam. For the manufacturing of electrical appliances, Ontario offers a field, at the present time, which cannot be duplicated by any part of America. Is there not here room for a little British enterprise too?

The Ontario Power Co. at Niagara Falls have ordered three more generators with turbines to drive them, and they will be installed as soon as received. They will be capable of producing 12,500 H.P. each, being duplicates of generator No. 4 now installed in the power house, which is one of the largest machines of its kind in the world. There are now four generators in the company's power house, and when the three new ones are installed the available space will all be occupied, and the seven units will take all the water supplied by the present conduit, to run them.

Nova Scotia.—At the Chignecto coal mines a power plant has been erected, and it is proposed to supply electrical energy to the various townships in the immediate neighbourhood, by means of overhead wires. It appears that a quantity of the coal mined is not of a marketable quality, and it is hoped that by using specially-designed boilers this can be utilised at the pit mouth in the electricity supply business. We gather that a transmission line has been erected from the mines to Amherst, 40 miles distant, and that it is likely that about 3,000 H.P. will be delivered to the city. The city being a manufacturing centre, if the experiments prove successful, there should be good prospects for the subsidiary undertaking. Nova Scotia possesses large coalfields, and, curiously enough, very little water-power.

The report of the engineer in charge of the Georgian Bay-Ottawa Canal survey will show the feasibility of a hydro-electric development of 1,250,000 H.P. along the route. It is now claimed that an expenditure of $100,000,000 would be justified by the increased facilities afforded for transporation of the products of the west to the seaboard by this great waterway, and if this great electric development can be realised, there would be a greater incentive to construct the work as a national undertaking.

Cannock.—The B. of T. has approved of the transfer of the E.L. order of the U.D.C. to a private firm.

Colchester.—The Electricity Committee, on the recommendation of its engineer, has decided to scrap the storage battery at the generating station, with the exception of a few cells sufficient to light the station. The Council, however, is not satisfied that the engineer and the committee are acting wisely, so an expert is to be obtained to report on the matter.

Continental Notes.—Germany.—The town of Wattenscheid, in Westphalia, is raising a loan of 1,230,000 marks in order to join an electric engineering firm, viz., the Electricitatswerk Westphalen, in the construction of electric tramways and in electric light and power supply for the town.

Hungary.—The municipal authorities of Baja are about to invite tenders for the concession for the electric lighting of the town.

Turkey.—According to the Vienna *Elektrotechnik und Maschinenbau*, the Turkish Government have just granted a number of concessions for electric undertakings in quick succession. To the Minister of Justice and Worship, a concession for an electric tramway and electric lighting scheme between Kadikeny and Scutari has been accorded; to the Grand Master of Artillery has been granted a similar concession for an installation between Beschitask, Topané and the Yildiz Palace district; and a third concession of a similar character in the city of Aloppo has been given to a son of the Sheik ul Islam.

East Ham.—On the suggestion of the engineer, the charge for incandescent electric street lighting is to be reduced from £3 5s. to £2 15s. per annum per lamp. The Public Health Committee, after having fully discussed the question with the Medical Officer of Health and the electrical engineer, has decided to install electrical machinery for the laundry. Tenders are to be invited for this.

Grimsby.—The T.C. has decided to apply to the B. of T. for an E.L. prov. order for Immingham and other parishes in the district.

Hastings.—The T.C. has decided to apply to the L.G.B. for a loan of £4,400 for house services and mains.

Highbridge.—An E.L. scheme has been submitted to the U.D.C. by Messrs. Jacques, Clutton & Jacques, of Burnham, and is being considered by a committee.

London.—Hammersmith.—The B.C. holds the monopoly for the supply of electricity required at Olympia for seven years as from January last. The Council is only able to supply alternating current, and in a report on the subject, the borough electrical engineer stated that, at recent exhibitions held there, the demand for a direct current supply was so large that the organisers were put to great expense (exclusive of a royalty to the B.C.) in installing a temporary steam generator to meet this demand, and that such recurring expense for temporary plant is a waste of money. The new Olympia Co. has approached the Electricity Department in regard to a supply of continuous current. On the electrical engineer's recommendation, the Lighting Committee has decided to offer to install two 150-KW. motor-generators, at an estimated capital cost of £1,400, and to supply energy to the A.C. side of these sets at 2d. per unit, the increase of 1d. per unit being made to cover the capital cost of the plant.

Islington.—Judging by the long discussion which took place at last Friday's meeting of the B.C., economy is to be the order of the day. The chairman of the Lighting Committee remarked that he took the results of the late election as a mandate that it was not yet necessary that large extensions to street lighting by electricity should be carried out. The inquiry which has been instituted into this question will be an exhaustive one. Alderman Wylie said that pillars which had been put in *cul-de-sacs*, which the late Committee and Council decided to light up like Parisian boulevards, are to come down. The committee of inquiry was enlarged by including all chairmen of the prominent committees of the Council.

Woolwich.—At the meeting of the B.C. on the 6th inst., the Finance Committee recommended that arrangements be made for an overdraft of £63,000. Councillor Dawson said the reason the overdraft was required was chiefly on account of the deficiency of £42,000 in the electrical undertaking. Councillor

Widger said the deficiency on the electrical undertaking was the result of mismanagement by the Labour Party and the absurd manner in which the department was carried on by the late Council. The recommendation was carried.

L.C.C. Electric Supply Scheme.—After a long discussion at Tuesday's meeting, the County Council decided, on a division, by 70 votes to 32 to approve the Council's electric supply Bill, to affix the seal to a petition for leave to bring in a Bill, and to deposit the Bill and petition in accordance with the Standing Orders of Parliament. The Bill, as submitted by the Parliamentary Committee, provides for an area of supply in the County of London and in certain parts of the Counties of Essex, Kent, Surrey and Middlesex, and power is sought to acquire sites on the banks of the Thames at Barking and Erith for the erection of generating stations. It is also proposed to seek authority to take over the undertakings of the Borough Councils, and to transfer to the County Council the powers of purchase of undertakings now possessed by the Borough Councils and the other local authorities within the area of supply. The Finance Committee, in reporting on the proposal, stated that considerable financial risks were inseparable from the establishment of an undertaking of that nature and extent, particularly the risk of deficiencies in the early years. In the opinion of the Committee, while the Council should be constituted the central authority, the powers sought by the Bill should be as wide as possible as regards the way in which the powers might be put into execution by the Council. The Select Committee of 1905 pointed out three ways in which the County Council might exercise its powers, and the Finance Committee submitted that the financial difficulties of the scheme would, to a large extent, be avoided if the Council adopted some such scheme by which, while retaining general control, the Council would be relieved of the responsibility of working the undertaking in whole or in part. Notwithstanding this warning, and the protests of the minority, the County Council has agreed, as already mentioned, to proceed with the Bill on the lines set forth, although the Parliamentary Committee has been authorised to make any alterations in the Bill that may be considered desirable.

Lowestoft.—The accounts of the Lowestoft Corporation electric light undertaking for the year ended September 30th show a balance of £109, after providing £4,392 for interest and sinking fund. Commencing on April 1st, 1907, the Electric Light Committee recommends that energy for private lighting should be charged for at a flat rate of 4½d. per unit, that for traction purposes it should be 2½d. per unit for the first 200,000 units, and that all above that total should be charged for at 2d. per unit. The Committee also recommends that energy for private power and heating should be charged for at the rate of 2d. per unit for the first 2,000 units, and at the rate of 1½d. per unit for all above that total.

Maidstone.—A L.G.B. inquiry was held on Friday into the unopposed application of the T.C. for a loan of £1,500 for additional plant at the electricity works.

Newark.—An object-lesson on how it is possible to waste time in endless discussions, which bear no fruit, is furnished by the actions of the Newark Town Council in relation to the public supply of electricity. More than seven years ago the aldermen and councillors were considering whether the electric light should be installed, and there is not a single wire laid yet. For a considerable period before November, 1899, the Council had appointed an Electric Lighting Committee, which talked a great deal about the light of the future, and in that year notice was given to apply for a prov. order to enable the Corporation to carry out a public undertaking.

The order was granted in the session of 1900, and in the summer Mr. Vesey Brown was instructed to prepare a scheme. Meanwhile, some of the members who were foremost in supporting a Corporation scheme, in course of time changed their views, and became strong advocates of treating with a private company to carry it out, and *vice versâ*. The cost of obtaining the order was £300, and a site was purchased for a generating station at £700, with an extension of ground, the price of which was £500. Mr. Vesey Brown prepared two schemes, one to cost £20,000 and the other £30,000 to carry out, the first being adapted for only part of the area of the borough. In November, 1900, a resolution authorising the preparation of the plan was carried without a dissentient. By May, 1901, the Corporation had applied to the Local Government Board for power to borrow £30,000.

At this time the Derbyshire and Notts Electric Power Co. had promoted a Bill in Parliament to enable it to supply electricity in bulk, and the Council opened negotiations with that company. There were interminable letters and interviews between the chairman of the Committee and the company as to price, and the L.G.B. wrote requiring the Corporation to finish its negotiations with the company before the Board would sanction the loan. The company would not state definitely when it would be prepared to supply, and in December, 1901, it was decided that if the company did not offer terms by January 7th, 1902, the Council would inform the L.G.B. that it had decided to supply the borough with electricity itself. In January the company offered to supply at 4d. per unit for both light and power. Another delay was caused by the company having to obtain a new Act enabling it to erect generating stations on any site within its limits of supply, and this the Corporation had to oppose in order to protect the supposed interests of the borough. The letters and the talk went on; all the time interest was being paid on the cost of the site for a generating station, and Mr. Vesey Brown was asking for payment on account for preparing his schemes.

In July, 1903, the Council came to an agreement with the Notts and Derby Co. to supply at 4d. per unit for lighting and 2d. per unit for power. But nothing was done to carry it out. In February, 1905, some of the capitalists interested in the Derbyshire and Notts Co. obtained from the B. of T. powers to construct electric tramways; the tramway company was given three years for completion, but not a rail has been laid yet.

A new Bill was promoted by the Derbyshire and Notts Co. in February, 1906, by which it sought power to take over the tramways scheme, to retail electricity, to take itself out of the borough building by-laws, and practically to oust the Corporation from control of the electrical supply. This the Corporation opposed, and on March 31st it was stated that the B. of T. had allowed the Corporation's order to remain in operation for 12 months longer. The town was said to have been out of pocket only £50; the cost of the site and the law expenses having been refunded by the company when the agreement was signed.

The latest step taken by the Corporation is the issuing of a notice of application to the B. of T. for an amended order authorising the Council to transfer its order to any company with which it may be able to agree. The official notice respecting the new order was recently published. Meanwhile the town has neither tramways nor a public supply of electric light and power, though a few firms have put down private electrical plants for the supply of their own premises.

Otley.—The U.D.C. has applied to the B. of T. for an extension of the E.L. order.

Runcorn.—Messrs. Crompton & Co. have informed the U.D.C. that they do not at present intend to proceed further with their application for a prov. order for electric lighting owing to the present state of the money market.

Sevenoaks.—The U.D.C. has decided to ask the B. of T. if it is satisfied with the progress being made by the company which possesses the prov. order for electric lighting.

South Africa.—East London.—The Town Council, having failed to make any arrangement with the Harbour Board for the acquisition of the generating station and plant of the latter, has now decided to proceed with the scheme of reorganisation and reconstruction of the electric light and tramway systems at a cost not exceeding £50,000. Tenders are to be obtained forthwith for the erection of the buildings, and the supply and erection of the plant. The reconstruction will be on the lines of the reports drawn up by the town electrical engineer (Mr. J. Mordy Lambe), the borough electrical engineer of Durban, and the city electrical engineer of Cape Town, dated May, 1906.

Germiston (Transvaal).—The T.C. has approved of the application by the African Concessions Syndicate, Ltd., for an electric power line along the East Rand.

Cape Town.—The city electrical engineer has supplied the Electricity and Waterworks Committee with particulars of quotations received from Messrs. Babcock & Wilcox for the supply of stoking machinery at an estimated cost of £2,377, to enable the Council to be in a position to utilise Natal coal at the electricity works. The Committee has considered the matter, and is assured that the actual saving with the use of mechanical stokers and superheaters will be sufficient during the first year that the plant is in use to extinguish the capital expenditure under this head. Therefore, it is recommended that the machinery be imported forthwith.

Johannesburg.—The tramway, electric lighting and power supply services for the whole of the municipality, we understand, are now almost complete. The scheme is of special interest in that producer gas is to be used with engines of 1,000 and 2,000 H.P. In view of the unfavourable reports which have been published respecting the plant, it is, perhaps, but fair to state that starting difficulties have been accentuated by local conditions, and by the loss of material at sea. The death of the contractors' chief engineer also caused further difficulties.

The contractors have undertaken a running contract for a year at a price that practically confirms the estimates of the Council's advisers. The total cost of the scheme is somewhat under the original estimates.

Wolverhampton.—In a report issued by the Electricity Committee of the Corporation, it is stated that the Committee has had under consideration the question of the disposal of the four rope-driven generators which belonged to the engines disposed of by the Committee in December, 1902, and six 45-KW. transformers for transforming from 1,800 volts to 110 volts. These formed a part of the old high-tension system of generation and distribution; owing to the alteration in the method of supply, they are no longer required. The electrical engineer stated that the cost of rewinding the generators to enable them to be used in conjunction with the present system of supply would be too high. Therefore he has taken the scrap value only. As a result of the engineer's calculations, it has been found that the original cost of the machines amounted to £5,245, their present scrap value is £657, the amount repaid by the operation of the sinking fund is £2,386, and consequently the balance to be provided out of reserve fund to extinguish the remaining debt is £2,202. The Committee therefore recommended the Council to sanction the disposal of the plant in the manner indicated, and at the meeting of the T.C. on Monday a resolution was passed endorsing the views of the Committee.

The Council has also decided that the mains in the borough be extended, at an estimated cost of £1,132.

(*Continued on page* 959.)

THE SNOWDON HYDRO-ELECTRIC INSTALLATION OF THE NORTH WALES POWER AND TRACTION CO., Ltd.

(*Concluded from page* 919.)

Of the two sub-station buildings at the Oakley Quarries, one (fig. 17) is divided into three separate lock-up rooms, which accommodate respectively the H.T. switchgear, the transformers, and the L.T. switchgear. The incoming H.T. feeders enter a tower at one end of the building, passing down to the H.T. switchgear, where they connect to three bare overhead bus-bars; the latter feed through section switches, to two H.T. panels equipped with Ferranti triple-oil switches with overload attachments and current transformers. Bare leads pass from the H.T. oil switches over a partition to supply the primaries of the two transformers, which are each of 500 KW. capacity, of the Bruce Peebles oil-cooled type, with a step-down ratio of 9,400-520 volts.

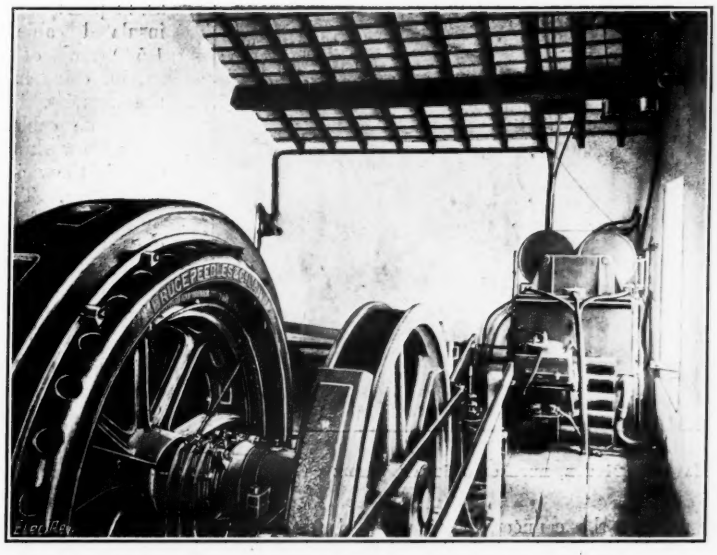


Fig. 27.—View in Haulage Motor House, Oakley, showing Induction Motor and Operating Switchgear.

The transformer secondary leads pass over a similar partition to the L.T. bus-bars, from which the outgoing quarry feeders pass through triple oil switches of the Siemens-Schuckert type, with overload attachments, up another tower and out through ducts in the wall, in the usual way.

Both the H.T. and L.T. switchgear are protected by lightning arresters of the B.T.-H. and Siemens type respec-

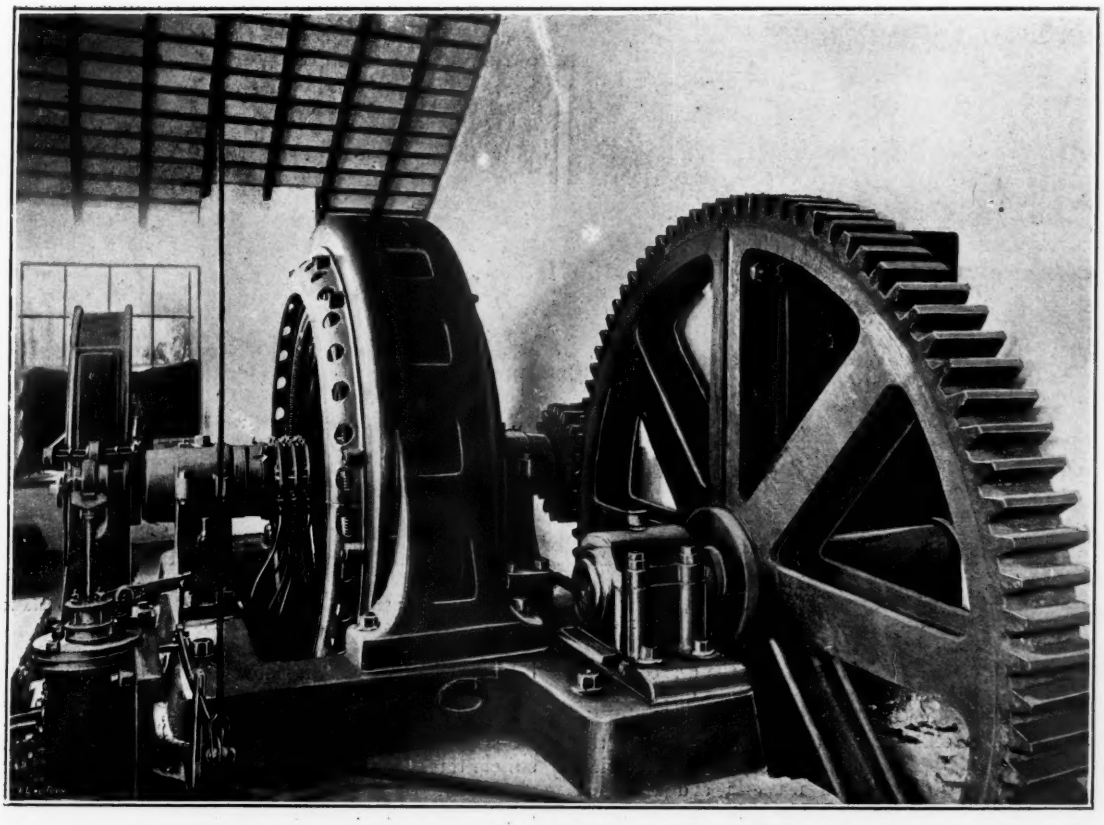


Fig. 28.—Peebles 200-H.P. Induction Motor for Incline Haulage, Oakley.

tively, installed in the towers; and, for the operators' safety, all live parts within reach are enclosed by wire grillages, and the floors covered with insulated teak platforms.

The other sub-station, shown in fig. 22, is of slightly different design in that only two compartments are provided, one containing the H.T. switchgear and transformers, and the other the L.T. gear.

The entering transmission lines and H.T. switchgear are similar to the previous case, but the connections to the transformer primaries lead from the H.T. bus-bars through Callender dividing boxes to three-core paper-insulated lead-covered and armoured cables: these run under the floor and up the sides of the transformers, where bare leads issue from similar dividing boxes, and connect to the transformer terminals. Views of the H.T. switchgear and transformers were given on p. 918. The six secondary connections pass down in a similar manner under the dividing wall to the L.T. compartment, and up through switch fuses to the three L.T. bus-bars. The latter are carried on insulators supported on slate partitions, which form cells for L.T. triple oil switches (of the Siemens-Schuckert type), and from which the outgoing feeders to the local transmission network, and armoured interconnecting cable to the other sub-station, pass out.

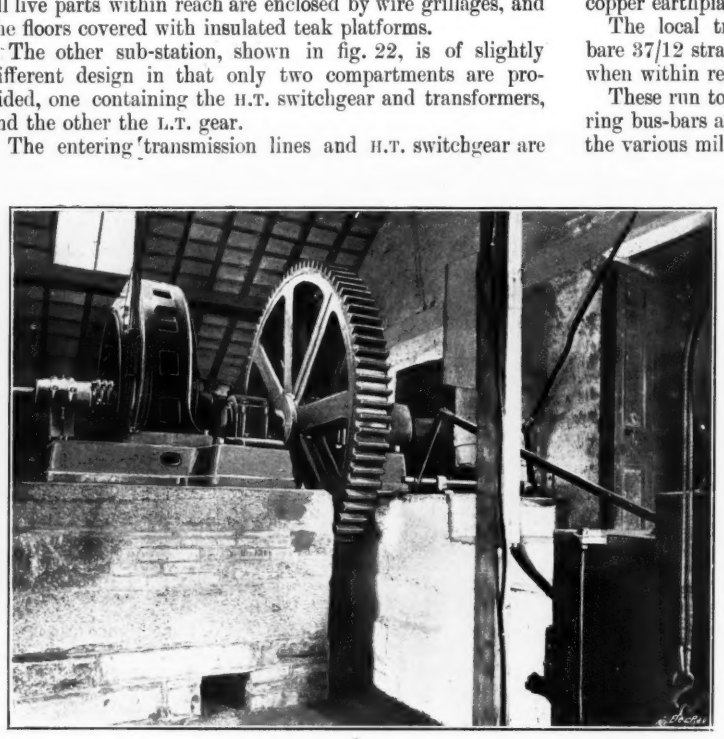


FIG. 29.—PEEBLES HAULAGE MOTOR, REPLACING STEAM WINDER, OAKLEY.

In both sub-stations the power requirements of the quarry are metered on the L.T. side, and all metal work, cable armouring, &c., is substantially earthed on to built-up copper earthplates.

The local transmission network is composed largely of bare 37/12 stranded cables run on wooden poles, but braided when within reach.

These run to four distributing poles fitted with miniature ring bus-bars as shown in fig. 39, from which lines branch to the various mills, &c.; all connections pass through isolating links on the bus-bars, so that any cable can be repaired without disturbing the local transmissions as a whole.

It must be understood, however, that all the low-tension distribution is not on the overhead principle in this quarry, as, in point of fact, a large amount of insulated cable has been run, some 1,500 yards of rubber-covered 3 × ·05 sq. in. cable having been used about the quarries. A length of ·25 sq. in. three-core cable, 800 yards in length, feeds the workings at the bottom of the shaft in the vicinity of the Oakley No. 2 sub-station. This cable, which is held up to the roof of the working by iron clips and grouted-in rag bolts, runs to a distributing station for supplying—through three triple oil switches—pumps and haulages at different levels. The underground insulated cable runs from this point comprise some 2,000 yards of three-core paper-insulated, lead-covered and double-armoured cable supplied by Messrs. Siemens Bros.

Some incandescent lighting is also supplied through single-phase transformers from this point, the lighting leads being twin lead-covered cable run along the roof of the workings; single lamps are fixed at intervals, being mounted on wood bases and provided with glass covers.

In regard to the various motor applications, it will be sufficient to cite some typical examples. The mills are throughout operated by squirrel-cage motors with a speed of 600 R.P.M., and bolted on the wooden tie-beams of the roofs; the group system of driving is adopted, through back gear, belting and shafting. The motor leads are bare cables run on bobbin insulators along the roof beams to the end of the building, where the motor-control apparatus is fixed. The latter consists of an iron-clad fitting containing the main switch, three Mordey enclosed type fuses, and an ammeter, also an auto-transformer below, fixed to the wall. Fig. 36 is a typical mill view, showing the squirrel-cage motor overhead and fig. 35 shows the switchgear employed.

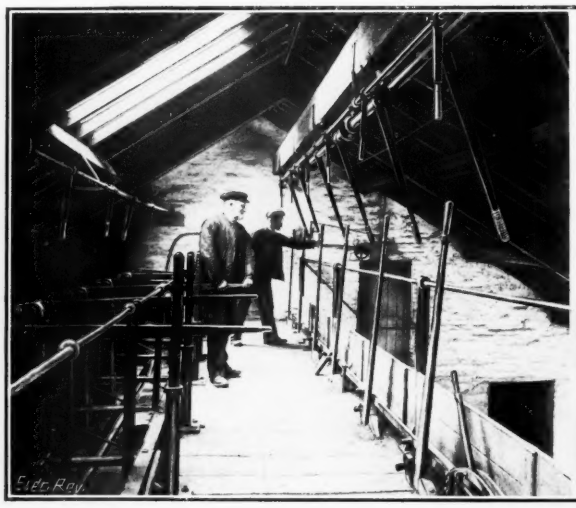


FIG. 30.—DRIVER'S PLATFORM, OVER INCLINE, SHOWING LEVERS FOR OPERATING MOTOR SWITCHGEAR, BRAKES, &C.

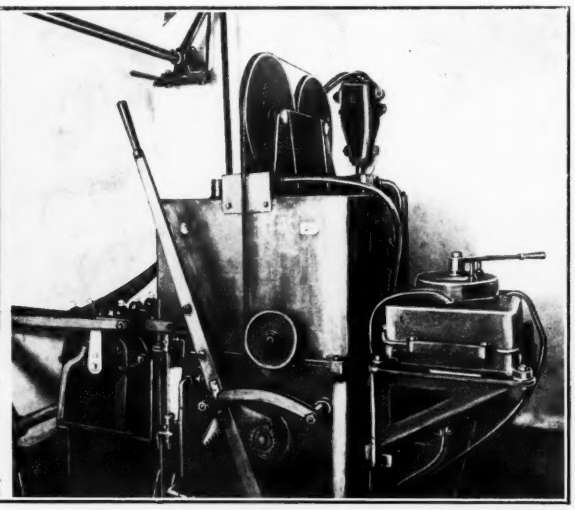


FIG. 31.—PEEBLES LIQUID STARTER, REVERSING AND MAIN SWITCHES, FOR 200-H.P. MOTOR.

Of the underground pumping plant, a good example is a

two-stage Worthington centrifugal pump, with a capacity of 800 gals. per min., against 220 ft. head; this is direct coupled to a 150-H.P. Bruce Peebles B.S.-type motor with a speed of 1,500 R.P.M., the motor, including the slip-rings, being totally enclosed. The operating switchgear is bracketed to the adjacent rock walls. Figs. 34 and 37 show the above pump and a portable pump of similar type.

For supplying compressed air in the workings, a new plant has been installed on the surface.

This includes an Ingersoll Rand compound-air compressor, belt-driven from a 150-H.P. Bruce Peebles induction motor, with a speed of 500 R.P.M.

The main switch is of the triple oil break pattern, and a liquid controller is installed for starting purposes.

Turning to incline haulages in which the haulage drums are arranged according to circumstances, one which we had the pleasure of inspecting, had the drums with the engine man's platform and controlling levers, fixed overhead at the top of the incline. The driving motor, one of five 200-H.P. 30-pole induction machines with a speed of 200 R.P.M., now occupies the place of honour in an adjoining engine house, and drives—through a flexible coupling—a horizontal shaft which actuates the winding drums, through clutches. Views of this motor and switchgear are shown in figs. 27 and 28.

The motor is of Messrs. Bruce Peebles' standard type, with a wound stator — the slots being of the semi-closed type — and bar-wound rotor built up on a spider.

FIG. 32.—PENYRORSEDD QUARRIES: VIEW OF THE WORKINGS AND AERIAL ROPEWAYS.

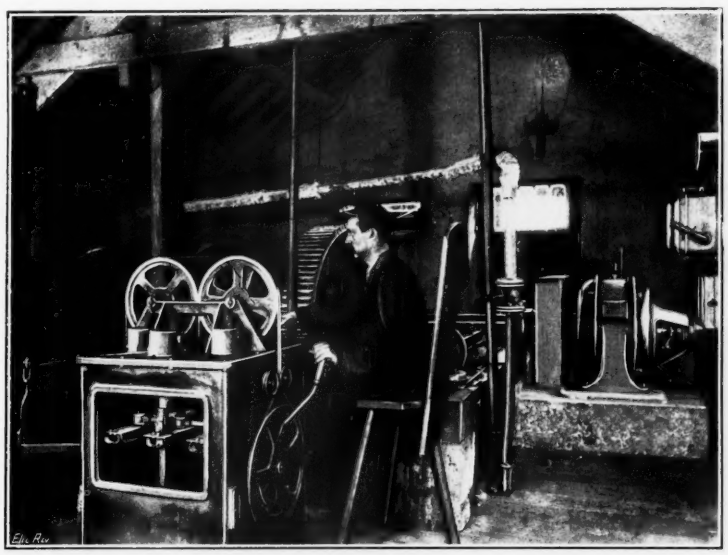


FIG. 33.—PENYRORSEDD QUARRIES; PEEBLES ELECTRICAL HAULAGE GEAR WITH 80-B.H.P. MOTOR.

The slip-rings are mounted on the shaft beside the rotor, and on the end of the shaft is the emergency air-brake drum, these features being clearly seen in fig. 27.

The motor can be supplied with energy from either sub-station, *i.e.*, a three-core cable runs in, in one direction, and an overhead transmission enters from another.

The motor control gear is installed beside the motor, and includes a Bruce Peebles liquid controller, main and reversing switches, which are worked by levers from the driver's platform outside. Fig. 31 shows the arrangement of the switch-gear in connection with the 200-H.P. motor above referred to; the liquid controller in the rotor circuit permitting of exact speed control, being shown in the centre, with the reversing switch to the right and oil-break main switch to the left. The reversing switch is seldom used, as the trolleys can in any case run back on the brake; the other switches are worked by means of a suitable mechanical leverage from the driver's platform, shown in fig. 30. The switchgear, &c., is protected by lightning arresters hung from the roof: air brakes are provided to the winding drums. Similar arrangements obtain in the case of the smaller 75-H.P. haulage motors, and in some cases the discarded engine remains as a stand-by.

Particular attention has been given to the earthing of all machines, cable armouring, guard wires, &c., some 45

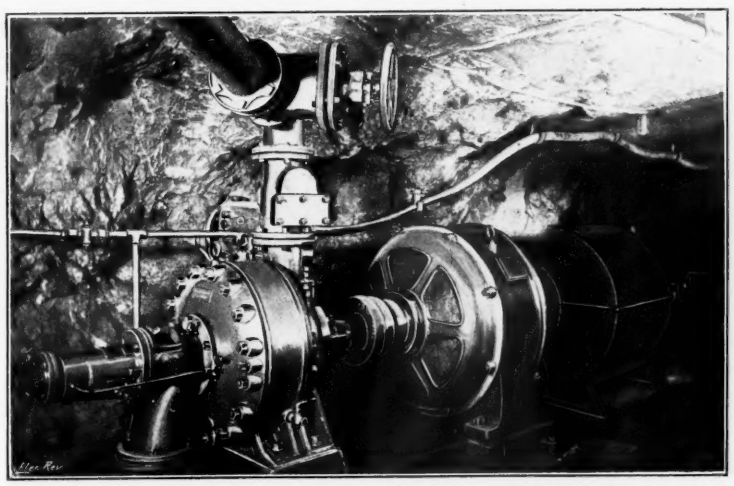


FIG. 34.—UNDERGROUND TURBINE PUMP WITH 150-H.P. PEEBLES TOTALLY ENCLOSED SLIP-RING MOTOR.

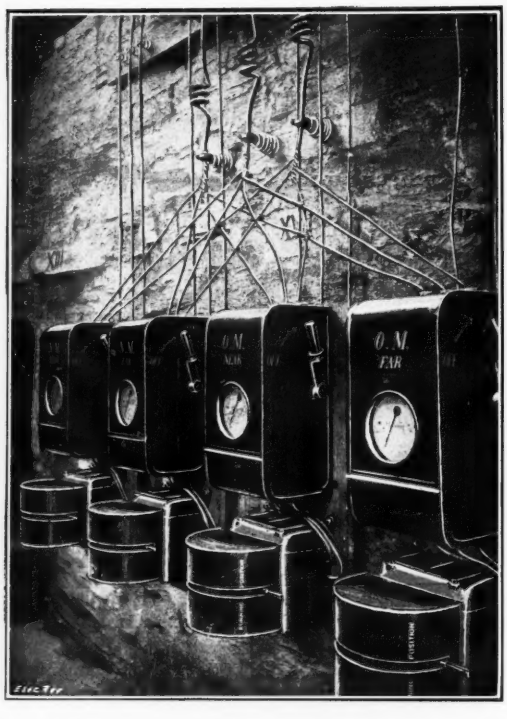


Fig. 35.—Standard Switchgear for Squirrel Cage Mill Motors, Oakley.

copper and zinc earth-plates being employed, sunk in water courses and similar positions where a good earth was likely to be obtained.

The Penyrorsedd Quarries are open workings, the material being hauled to the surface on aerial ropeways as shown in fig. 32. One sub-station supplies the load, a view of which, with the incoming H.T. and outgoing L.T. lines, was shown in fig. 20.

For driving sawing and trimming machinery in the lower mill two 20-H.P. motors are installed; while in the middle and upper mills a 40-H.P. motor suffices in each case for similar work.

In addition a 20-H.P. motor is installed for operating wood-working machinery, and the remaining motors, making up the total of 750 H.P., are 80, 75, 50 and 40 H.P. induction motors for working the haulages in connection with the aerial ropeways.

A view of one of the haulages equipped with an 80-B.H.P. motor and a liquid controller, both of Peebles type, is shown in fig. 33; the haulage cable passes from the cabin up to the top of a mast, from which the aerial haulage leads into the quarry.

Messrs. Bruce Peebles were contractors for both the Oakley and Penyrorsedd installations, with Messrs. Siemens Bros. as sub-contractors for the secondary distribution in the former case.

The Dinorwic Quarry is worked in terraces cut in the mountain side, these being clearly visible in fig. 15, and some idea of its size will be gathered from the fact that 3,000 men are employed: the slate is sawn, split and trimmed in mills perched on the ledges, and subsequently loaded into trolleys which are run down inclines, by gravity, to sidings, where they are collected for haulage by private railway to Dinorwic Harbour and the railway at Port Dinorwic.

The mills offer a good power load—the inclines, needless to add, do not.

At Dinorwic the H.T. line enters a sub-station at the base of the mountain—a small building with a leading-in tower above, shown in fig. 21, and leaves again for another sub-station at a higher level; the lower building at present supplies some 20 KW. of lighting, and the upper one 250 H.P. of motors. The H.T. leads into the sub-station are mechanically clamped on to the transmission lines and pass in through inclined earthenware pipes in the sides of the tower, the pipes being provided with paraffined wood diaphragms as at the power station: the leads pass thence to the H.T. panels which occupy one side of the building, with the L.T. panels facing them on the other side. The H.T.

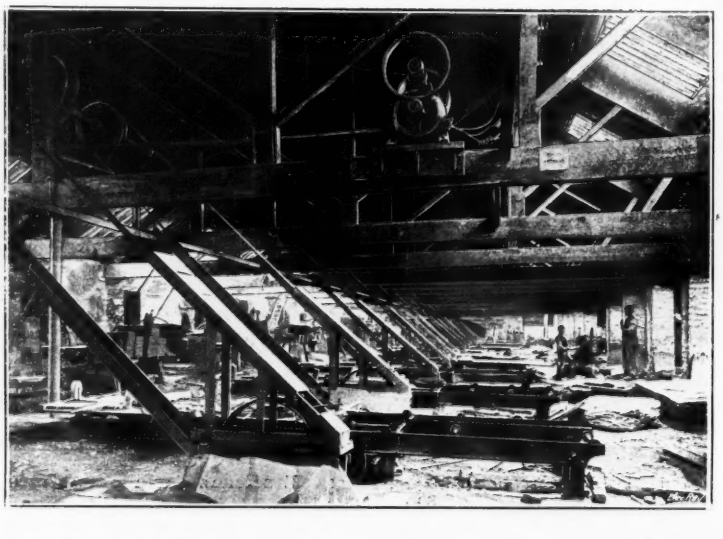


Fig. 36.—View in Mill, showing Squirrel Cage Motor Mounted in Roof.

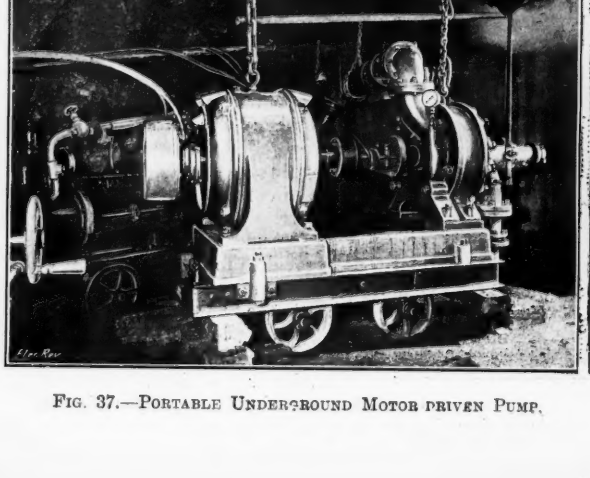


Fig. 37.—Portable Underground Motor driven Pump.

Fig. 38.—Peebles 60-H.P. Underground Haulage.

side of the building is shown in fig. 25, the panels being of white marble, each equipped with an oil switch with time-limit overload relay, and a B.T.-H. watt-hour-meter; the transformers in the corners and the H.T. gear, as a whole, are protected by a wire grillage, not shown in the illustration.

Both the H.T. and L.T. gears are protected from static interference by B.T.-H. lightning arresters.

This installation was carried out by the owners of the quarry.

It only remains to refer to the prospects of the undertaking, which are, commercially, of a very hopeful character. The normal price for this class of supply averages ⅞d. on a sliding scale, and considering the cost of delivering coal in these somewhat inaccessible situations, and the many well-known advantages of electrically operating isolated machinery, little doubt can exist as to the ultimate success of the scheme. In the case of the Penyrorsedd Quarry, the company made a sporting offer to operate at three-quarters

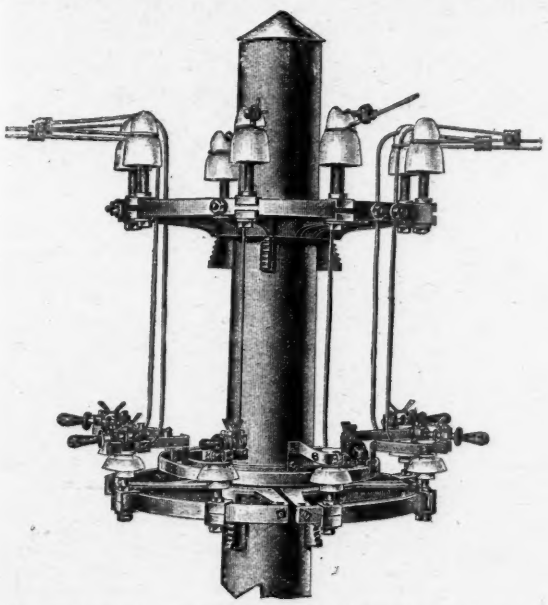


Fig. 39.—Type of Distributing Pole (Adapted to Three-Phase) used at the Oakley Quarries.

of the previous cost by steam driving, and we understand that this arrangement has proved extremely satisfactory to both parties—it is even suggested that the power company regrets the existence of the aforesaid sliding scale in this case.

As we have previously hinted, it is not only in this direction that power will be required; both slate and tourists require transport facilities, and that electric traction will supersede the present slow and antiquated arrangements can hardly be doubted.

Already the company is interested in a 30-mile 2 ft. gauge railway, which includes and extends the present south Snowdon line. This line, which will connect Carnarvon with Port Madoc, *viâ* Dinas Junction, Beddgelert, which possesses only coaching facilities at present, and the celebrated Aberglaslyn Pass, is on the way towards completion.

Its construction entailed tunnelling through the solid rock in the Pass, a work which has, however, been carried out without interfering with the scenic beauty of the surroundings.

It is intended to operate the line on the three-phase system, and some interesting electric locomotives constructed by Messrs. Bruce Peebles for this service were mentioned in the Electrical Review of November 24th, 1905.

In conclusion, all credit is due to Messrs. Bruce Peebles and Co., whose enterprise and skill has resulted in the successful carrying-out of this unique British scheme of power supply; we are much indebted to them for facilitating our visit to this interesting installation. With them we associate Mr. W. V. Waite, their resident engineer, who has borne the brunt of the constructional operations from the commencement; Mr. Obornyak, who has supervised the transmission work; Mr. G. K. Paton, of the firm's Edinburgh staff and Mr. Norman D. Cameron, who accompanied us on our visit. To all of these gentlemen we are indebted for courteously assisting us in the preparation of this article. It is interesting to note that the chief engineer of the North Wales Co. is Mr. A. W. Beuttell, of Linolite fame, and late with Messrs. Bruce Peebles & Co.

LIGHTING and POWER NOTES.

(*Concluded from page* 954.)

Standish.—The B. of T. having asked the U.D.C. what steps have been taken towards carrying out the E.L. order, the Council has replied that nothing as yet had been done, but it is quite prepared to proceed when sufficient demand arises to justify the cost.

Stretford.—Mr. T. L. Miller, of Manchester, has been re-appointed consulting engineer to the Stretford U.D.C. for the year ending October 31st, 1907, at a fee of 25 guineas, covering the quarterly preparation and submission of reports on the working of the station and plant.

Worksop.—After a heated discussion, the U.D.C. recently adopted the recommendation of the committee to extend the electric lighting mains.

TRAMWAY and RAILWAY NOTES.

Acton.—Last week the U.D.C. had before it a notice from the County Council giving intention to almost immediately open up certain roads in the district for a tramway connecting Willesden with Acton. The U.D.C. decided to give formal notice of objection to enable certain agreements to be made.

Aston.—The T.C. has applied to the L.G.B. for a loan of £7,000 to defray the cost incurred in laying feeder cables, &c., in connection with the Erdington tramways.

Brentford.—Mr. T. Woodbridge, a local representative on the Middlesex C.C., stated recently that a committee of the latter had agreed to recommend the County Council to approve of the Brentford Council's scheme for widening High Street, Brentford, and to contribute a moiety of £96,000, provided that the London United Tramways contributed at least £10,000 towards the carrying out of the scheme. It was stated that the estimated cost of the work was £122,635, of which £96,000 was estimated for the widening and the remainder for the alteration of the tramway lines. The County Council is to consider the proposal on the 20th inst.

Continental Notes.—Spain.—A scheme has been launched to establish an electric tramway between Palma and Solter, and to provide the latter town with an electric light and power installation. The promoters of the scheme are the New York firm of Gramm & Co.

A company is in course of formation, having for its object the establishment of an electric tramway between Cadiz and Seville.

Coventry.—Owing to the increase in traffic the directors of the Coventry Electric Tramways Co. have decided to increase the generating capacity at the station by 300 kw., and to install additional condensing plant and superheaters, also to purchase six additional cars. The matter has been placed in the hands of the company's consulting engineer, Mr. I. E. Winslow, of Westminster, S.W.

Cuba.—A concession has been granted to a Mr. R. A. Betancourt for the right to build and work an electric tramway in the town of Camaguey.

Derby.—At a special meeting of the Town Council last Wednesday, Alderman Sprigg presented a report from the Tramway Committee recommending that tramways be constructed along the Ashbourne and Uttoxeter Roads. The former section is to be put down at an estimated cost of £16,800 and the latter at a cost of £12,810. In the case of Ashbourne Road it is proposed to put down double track, but in the case of Uttoxeter Road the thoroughfare is too narrow. After a long discussion the proposals of the Committee were agreed to, and it is understood that arrangements will be made to enable the extensions to be put in hand as soon as practicable.

Halifax.—In connection with the tramway disaster at North Bridge a few months ago, among the injured passengers was Mr. Geo. Coldwell, and the following arrangements as to compensation has just been agreed to by the Corporation, *i.e.*, to pay George Coldwell the sum of £1 per week during his life, such payments to date from the date of the accident, the Corporation to pay Coldwell's costs as between solicitor and client, and also his medical expenses.

Jarrow-on-Tyne.—The T.C. have prepared a memorial of objection to the proposed abandonment of the Albert Road section of the tramways by the Electric Traction Co., for presentation to the B of T. The memorial sets forth that "(*a*) The Albert Road section would be the most likely route by which through tramway communication could be ultimately established between South Shields on the east side, and Hebburn and Gateshead on the west side of the borough; (*b*) the Albert Road section would be the only means of tramway communication between the north and south portions of the borough; (*c*) had the Corporation been informed that this portion of the scheme would not be carried out, they would either have refused their consent, or have done the work themselves, and that the abandoment of the route would be detrimental to the interests of the town."

London.—L.C.C.—Owing to a car failing to take the right road, for some reason not explained, at Kennington Gate last week, two cars came into violent collision. Considerable delay was caused to the various services crossing that section, but, fortunately, no person sustained severe injury.

In connection with the purchase of the tramway from Camberwell and Norwood to Vauxhall, belonging to the London Southern Tramways, the arbitrator, we understand, has fixed the price at £60,000, exclusive of interest, which will be likely to amount to £5,000.

The Highways Committee has prepared a new scheme of bonuses for its motormen. It proposes to distinguish, by a badge, men who have a satisfactory record, and from this superior class to chose men for working the heavy routes, &c. Extra pay will be granted for this work.

We learn from the daily Press that a trial trip was made over the new Embankment and Westminster Bridge routes on Monday night last.

Through Bookings.—Something new in the way of through bookings in this country, has been arranged by the London United Tramways, the District Railway and the Great Northern, Piccadilly and Brompton Railway. Combined tickets are to be issued, available over the Uxbridge, Hounslow and Hampton Court routes of the tramway system and any of the stations eastward of Hammersmith on the two railway companies' systems. Subsequently, when the Surrey lines of the L.U.T. system are completed similar bookings are to apply *vid* Wimbledon. We understand these new tickets are to come into operation on Saturday, the 15th inst., the day of the public opening of the G.N., P. & B. Railway.

L.C.C.—The Highways Committee, on Tuesday last, submitted a report in relation to the proposed reconstruction of the tramways from Vauxhall *vid* South Lambeth Road and Stockwell Road to Brixton Road, and the construction of new tramways in Merton Road and Mitcham Road, the total length being 5½ miles of single track. It was proposed to make junctions with the existing lines in Clapham Road and Brixton Road in the case of the Vauxhall scheme, and thus to afford accelerated services from Clapham and Brixton to Vauxhall and Victoria Stations. The total estimated cost of the work, including cars and proportion of sub-station plant, &c., amounted to £138,245. The consideration of the report was adjourned for a week, as also was a proposal to expend £9 000 on the provision of special brakes for the remaining 170 original cars which are still not equipped with such brakes.

Lowestoft.—The accounts of the Corporation Electric Tramways for the year ended September 30th, show a deficit upon the year's working of £2,117. Of this sum £890 has been provided for by the current borough rate, leaving £1,227 still to be provided. The consideration of a report by the engineer as to a suggested doubling of track, and the construction of a light railway to Kessingland, has been adjourned.

Manchester.—The strength of the bridge in Manchester Road, Chorlton-cum-Hardy—over which the Manchester Corporation desires to run electric cars to adjacent suburbs—has proved a bone of contention during the past week or so between the Cheshire Lines Committee on the one hand, and the Corporation on the other. The Manchester Corporation wishes to lay tracks to connect important suburbs, but the Railway Co. states that the strength of the bridge will not permit of the cars being run across, whereupon the Corporation states that if the bridge will not permit such ordinary traffic, then it is unsafe. It is a question of bearing the expense.

The B. of T. will probably settle the matter.

New Zealand.—Auckland.—The friction between the City Council and the Tramways Co. is growing acute, according to *Australasian Hardware*. There appear to be two matters in dispute. In order to secure a satisfactory track it was found necessary to drive piles into the roadway and practically relay the lines in sections. Who becomes responsible for the sewage channels under the circumstances? The second point is an alleged shortage of car accommodation. After some negotiations the Council instructed its solicitor to enforce payment for default at the rate of £8 per day.

Paddington.—On Saturday last, electric cars were run from the Royal Oak to College Park, over the first portion of the newly-electrified Harrow Road line. It is hoped that the whole line may be completed this month.

Poole.—The T.C. has received a letter from the B. of T. stating that the Board has appointed Mr. David Williams to act as arbitrator in the matter of the dispute with the Bournemouth Corporation as to workmen's fares. The proceedings are to be held in Bournemouth.

U.S.A.—A telegram from New York states that the first electric train was run on Tuesday on the New York Central. Henceforward a regular service will be run.

Yarmouth.—The Tramways Committee of the Great Yarmouth Town Council has decided to proceed with the construction of a tramway from that town to Caister, at an early date.

TELEGRAPH and TELEPHONE NOTES.

Hungary.—At the end of 1904 the total length of line in Hungary was 23,436 km., and of wire 124,134 km., being increases of 196 km. and 2,459 km. respectively. To accelerate transmission and connect up new offices, eight new circuits were created. The Hughes duplex system is worked between Buda-Pesth and Trieste, Lazrab and Fiume.

Successful experiments were made with wireless telegraphy between Buda-Pesth and Vienna.

The number of telegraph offices increased to 3,707, an increase of 120. There is one office for every 5,187 inhabitants.

The number of telegrams handled was 9,115 220, as against 8,296,428 in the previous year. Of these 5,707,459 were internal telegrams; 2,108,232 were exchanged with Austria; 134,874 with Bosnia, and 725,370 with other countries. There were also 439,285 transit telegrams. The increase for the year was 818,792 telegrams. Altogether 108,714,704 words were contained in the telegrams, as against 97,465.913 in 1903, being an increase of 11,248,791 words. Of the first-mentioned number, 6,762,390 words were transmitted by railway telegraph offices.

The average number of telegrams per inhabitant was ·5.

The telephone service developed in a satisfactory manner. During the year 22 new systems between towns were established, and six towns were supplied with systems. Altogether 143 exchanges were opened; 941 chief and 295 auxiliary offices were opened, while 316 and 96 respectively were closed. The system comprises 8,263 offices. The extension of line for the year was 2,989·7 km. of line and 23,197·3 km. of wire.

The number of conversations was 63,919 263, an increase of 8,472 592 over the previous year. Nearly the whole of the International conversations were with Austria; 61 946 956 conversations were exchanged between subscribers and 108,034 between subscribers and public call offices. The average number of conversations per inhabitant was 3·3.

The revenue from posts, telephones, and telegraphs is amalgamated, but it is possible to give the following figures:—The cost of maintenance of telegraph and telephone lines amounted to 1,833,909 fr. (about £73 356), while 56,682 fr. were spent in alterations, &c. (about £2,267). The revenue from the telephone service amounted to about 4,841,962 fr. (about £193,678).

Italy.—Reporting with reference to the Commission recently appointed in Italy to investigate the telephone service throughout the country, the United States Consul at Venice states that the moment seems most propitious for investigation by manufacturers, and since the Government will undoubtedly prefer a uniform system throughout Italy, an immense business may possibly be the reward of the successful bidder for the modernisation of the service in the first large towns in which it is undertaken under Government control. The central battery system is in use at Milan, and as it gives perfect satisfaction the tendency will be to adopt it generally. The Consul is of opinion that American desk telephones should find a ready sale in Italy. The only thing of the kind in use in Venice is a French production known as the Bailleux-Ader, which, although excellent as far as mechanism is concerned, is enclosed in a large wooden box, and is too heavy and cumbersome for convenience.

Police Station Telephones.—The police stations in the metropolitan area are at last to be connected to the telephone system. The City of London Police led the way last century.

Post Office Servants' Grievances.—The Parliamentary Committee which is inquiring into the alleged grievances of Post Office servants sat again last week, and heard evidence.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	.. Aug. 26, 1901 ..	..
Trinidad-Demerara (No. 2.)	.. Dec. 3, 1906 ..	Dec. 6.
Paramaribo-Cayenne	.. Nov. 27, 1906 ..	..
Cayenne-Pinheiro	.. Aug. 18, 1902 ..	..
St. Lucia-Martinique	.. May 7, 1902 ..	..
Dominica-Martinique	.. May 7, 1902 ..	..
Guadeloupe-Martinique	.. Aug. 29, 1906 ..	..
Mole St. Nicholas-Port au Prince	.. Aug. 16, 1906 ..	..
Curacao-Coro		
Curacao-La Guayra } Closed..	.. Jan. 12, 1906 ..	..
Curacao-Maracaibo		
Reissa-Issa and Reissa-Yemani (Yemen)..	.. Oct. 22, 1902 ..	..
Tarifa-Tangier	.. Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	.. Mar. 9, 1904 ..	..
Garachico-Santa Cruz	.. July 12, 1906 ..	..
Las Palmas-Arecife	.. Aug. 18, 1906 ..	..
Guantanamo-Mole St. Nicholas	.. Nov. 22, 1906 ..	..
Mole St. Nicholas-Cap Haytien	.. Nov. 22, 1906 ..	..
Gibraltar-Tangier	.. Dec. 3, 1906 ..	..
Fao-Bushire	.. Dec. 4, 1906 ..	..
Landlines.		
Puerto-Barrios	.. Aug. 28, 1903 ..	..

Telephone Agreements.—An interesting case was heard at the City of London Court last week. It appeared that a P.O. subscriber, David King, gave verbal notice to discontinue the use of

the telephone at the end of the first year, but did not give the three months' written notice required by the agreement; the Postmaster-General disconnected the telephone, and sued the subscriber for £5 10s. for a second year's telephone charges and calls. Judge Rentoul said the agreement was unreasonable; he could not understand why a man should have to pay for his telephone when it had been removed, and for calls which he could not make, and he gave judgment with costs for the defendant.

Wireless Telegraphy.—The judgment given last May by the United States Patent Office in the actions Marconi *v.* Shoemaker and Marconi *v.* Fessenden, whereby priority of invention of the magnetic detector was awarded to Marconi, has been confirmed on appeal.

The *Giornale d'Italia* announces that Signor Marconi and Prof. Artom have agreed to unite their respective systems of wireless telegraphy.

CONTRACTS OPEN and CLOSED.

OPEN.

Australasia.—January 14th. According to *Australasian Hardware and Machinery* tenders are being invited for telephones (9,000), magneto wall sets, for the Postmaster-General's Department, Commonwealth of Australia. Specifications, &c., at the Offices of the Deputy Postmaster-General, Sydney, Melbourne, Brisbane, Adelaide, Perth and Hobart. Tenderers to state name of country in which telephones will be made. Deposit, 5 per cent. on the amount up to £1,000, and 2½ per cent. on any further amount in excess of £1,000. Tenders to Deputy Postmaster-General, Melbourne.

Belfast.—December 31st. 1,000-KW. steam dynamo and condensing plant for the Corporation. See "Official Notices" December 7th.

Bray.—January 1st. High-tension switchboard and instruments for the U.D.C. electricity works. See "Official Notices" November 30th.

Bridlington.—January 19th. Pumping machinery for the Corporation waterworks. See "Official Notices" November 30th.

Bury.—December 22nd. Cables for the Corporation. See "Official Notices" December 7th.

Ebbw Vale.—December 31st. Prepayment meters for the U.D.C. See "Official Notices" to-day.

Felixstowe.—December 22nd. Switchboard for the U.D.C. See "Official Notices" December 7th.

Handsworth.—December 15th. Water-tube boilers, engine and dynamos for the U.D.C. See "Official Notices" November 30th.

Iceland.—March 31st. The Reykjavik Town Council is open to give a concession for the supply of electrical energy and gas. See "Official Notices" December 7th.

Islington.—December 28th. Fan 12 ft. diameter, and single-phase motor for driving same, for the Lighting Committee. See "Official Notices" December 7th.

Kingston-upon-Thames.—December 31st. Electric wiring of new schools for the Education Committee. See "Official Notices" to-day.

Launceston (Tasmania).—January 21st. Three-phase motors for one year. See "Official Notices" December 7th.

Portsmouth.—December 17th. Electric power cables for the Corporation works for the prevention of storm-water flooding. See "Official Notices" November 30th.

Stockport.—At a meeting of the T.C. estimates were considered for different work in connection with the completion and furnishing of the new Town Hall. The estimates included electroliers, £1,500; electric clocks, £300; and private telephones, £400. It was resolved that the architect should advertise for tenders for the electrical work, clocks and telephones.

CLOSED.

Athens.—The Athens and Piræus Tramway Co. have entered into a contract with Messrs. Bruce Peebles & Co., Ltd., for the electrification and reconstruction of the Athens tramways, including the supply and equipment of 100 cars, and the overhead equipment and track construction for a total length of 60 miles. The value of Messrs. Bruce Peebles & Co.'s proportion of the contract is approximately £300,000.

Australasia.—According to *Australasian Hardware and Machinery* contracts have been placed as follows for telegraph material at Burnie, Tasmania, for the Postmaster-General's Department, Commonwealth of Australia:—

R. Johnson, Clapham & Morris, Ltd., Sydney.—25 tons galvanised iron wire, 400 lb. per mile, at £13 5s. per ton.
Zwicker, Tod & Co., Sydney.—4,000 porcelain insulators, No. 5, large, 5½d. each.
India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., Melbourne.—500 shackle insulators, with galvanised iron bolts and straps, 11½d. per set.

Material to stores schedule, No. 15, for Postmaster-General's Department, Queensland, Commonwealth of Australia, as follows:—

21¼ tons H.D. copper wire, British Insulated & Helsby Cables, Ltd., Melbourne, £98 15s. per ton.
4,700 copper tapes (total), £12, 4,700 copper binders (total), £15, Brabant and Co., Brisbane.
600 McIntyre sleeves (total), £1 16s., 5,350 Acme insulators (total), £98 18s., Webster & Co., Ltd., Brisbane.
1 ton cup-head bolts and nuts, Federal Nut & Bolt Works, Ltd., Marrickville, N.S.W., £17.

Bradford.—The Corporation Electricity Committee has accepted the tender of Messrs. S. Parsons & Co., of Bradford, for the supply of ironwork for the new high-tension house, at £1,500.

Llandudno.—The U.D.C. on Saturday accepted the tender of Messrs. Bruce Peebles & Co. for the supply of a 350-KW. dynamo, at £1,790.

London.—L.C.C.—The Fire Brigade Committee of the L.C.C. received the undernoted tenders for the wiring and fittings for the Knightsbridge fire station:—

Smeeton & Page (recommended)	£154	G. Weston & Sons	£230
Blackburn, Starling & Co. ..	195	Durell & Co.	235
W. J. Fryer & Co.	197	Leo Sunderland & Co.	235
Frank Suter & Co.	218	Oliver Clark & Co.	235
Coleby & Co.	225		

The Highways Committee propose to extend the contract with Messrs. Reid Bros. so as to include the laying, at a cost not exceeding £6,200, of the cable ducts required in connection with the reconstruction of the tramways between Vauxhall and Brixton Road.

The tender of the British Westinghouse Co has been accepted by the L.C.C. to supply 50 sets of electro-magnetic brakes required for single-truck cars, at £32 per set.

Port Sudan.—Messrs. Crompton & Co., Ltd., have secured the contract from the Sudan Government for the complete electric lighting and power installation required for Port Sudan, to the specification of the consulting engineer, Mr. A. G. Marshall, 66, Victoria Street, S.W. The installation comprises:—Three Paxman Economic boilers with superheaters, and a Green economiser; two 200-KW. and one 100-KW. Allen-Crompton steam dynamos suitable for lighting and traction purposes, each set being provided with an independent condensing plant; reversible booster and balancer; main and auxiliary switchboards, together with all the necessary cable connections; the whole of the steam, exhaust, feed water pipes, &c., together with the feed pumps and feed water heater; a Tudor battery of 240 cells; the bare copper overhead lighting mains with insulators and wooden poles. The whole of the plant is to be delivered, erected and set to work by the contractors.

Salford.—The T.C. has applied to Messrs. F. Smith and Co. for the supply of 1,270 yards of trolley wire, at 1s. 0¾d. per lb., less 2½ per cent.

Shanghai (French Concession).—The French municipality of Shanghai has given an order to Messrs. Bruce Peebles and Co., Ltd., for 10 miles of electric tramway, including 30 cars, &c. The total of Messrs. Bruce Peebles' tramway contracts in Shanghai now includes the English, International, and French Concessions, involving 40 miles of track, 120 cars, and 2,000 H.P. of generating plant. The total value of these contracts is over £500,000.

West Bromwich.—The T.C. has accepted the tender of the Tudor Accumulator Co., Ltd., for the repair of the storage battery and its maintenance for 10 years.

Worcester.—The T.C. has accepted the tender of the Chloride Battery Co. for the supply of cells in sections with board separators, at 45s. per set until lead falls to £17 per ton, and then at 43s., and that of Messrs. Joseph Wood & Sons, Ltd., for engine house extensions, at £1,373.

Victoria Falls.—Much has been made of the great array of experts who have pronounced in favour of the practicability of transmitting electrical energy from Victoria Falls to the Rand; it would be interesting to know how many of these eminent engineers were led to form their good opinions of the scheme by virtue of its using the Thury system. If this system is not available, we presume the promoters will be compelled to adopt three-phase transmission, in which event, will the experts who blessed the scheme as a Thury, damn it as an alternating?

FORTHCOMING EVENTS.

To-day's Events (Friday, December 14th).—At 7 p.m. Physical Society. Second Annual Exhibition of Electrical, Optical and other Physical Apparatus. At Royal College of Science, S.W.

At 7.30 p.m. Institution of Electrical Engineers (Manchester). Mr. P. Lobel on "Design of Central Stations."

Northampton Institute Engineering Society. "Modern Common Battery Telephone Exchanges." By Mr. H. Cross.

At 8 p.m. Electro-Harmonic Society Smoking Concert at Holborn Restaurant. Further particulars in our "Notes" columns last week.

At 8 p.m. Institution of Mechanical Engineers. Meeting.

Monday, December 17th.—Institute of Marine Engineers. Meeting.

Tuesday, December 18th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). Mr. J. H. C. Brooking on "Cheapened Methods of Electrical Distribution."

At 8 p.m. Institution of Civil Engineers. Paper to be discussed: "Mechanical Considerations in the Design of H.T. Switchgear" by H. W. E. Le Fanu.

Thursday, December 20th.—At 8 p.m. Institution of Electrical Engineers (London). Mr. H. G. Brown on "The Track Circuit as Installed on Steam Railways."

At 8.30 p.m. Chemical Society. Meeting.

Friday, December 21st.—North-East Coast Institution of Engineers and Shipbuilders. Meeting.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, December 17th.—"A" Company, recruits' infantry drill, 6 p.m.; technical drill, 7 to 9 p.m.

Tuesday, December 18th.—"B" Company, technical drill, 7 p.m.

Thursday, December 20th.—"C" Company, infantry drill (Guard of Honour), 7.30 p.m.

Friday, December 21st.—"D" Company, technical drill, 7 p.m.

Saturday, December 22nd.—Men for Guard of Honour parade at Charing Cross (S.-E. & C.R.) Station 2.15 p.m.; train leaves 2.20 p.m.

No monthly orders will be issued in January, 1907.

WILFRID C. DUMBLE, Captain,
For O.C.E.E.R.E. (V.).

NOTES.

Christmas, 1906.—We shall be glad if all our friends will take note of the following arrangements that have had to be made in connection with the production of our issue of December 28th, in consequence of the closing of our various departments for the Christmas holidays:—

Articles and Correspondence for publication should, as far as possible, reach us by mid-day post on Saturday morning, December 22nd.

Late Notes and Notices should be received at our offices on the morning of Monday, December 24th.

Our Advertisement Department in making its announcement elsewhere in this issue, requests that:—

New advertisement copy and alterations to existing displayed advertisements, should be at our offices by the morning of Friday next, December 21st.

Official Notices and small prepaid advertisements will be in time if received by 9.30 a.m. on Thursday, December 27th, the day prior to publication.

National Electrical Manufacturers' Association.—We are officially informed that at a well-attended general meeting of this Association held on December 4th, with Mr. C. S. Northcote, M.I.E.E., in the chair, the Committee's work for the past six months was reviewed, and they were congratulated by the members on the important work undertaken, and the rapid progress which the Association was making in many and various directions. We are informed that quite a large number of members representing firms in the North of England, who have recently joined the Association, were present, and a very general expression of opinion was given that the Association had a great future before it. Amongst other matters brought under consideration was the question as to the next electrical exhibition, but this was felt to be somewhat premature, and the matter was left over till next March.

Standardisation of electrical catalogues was also discussed, and it was felt that the Association could not at the moment tackle this question.

We learn that a conference has been arranged between the Municipal Electrical Association and other bodies with which it is customary to issue specifications, and a Committee has been formed to represent the Association in bringing about improvements in the terms and the drawing of such specifications.

The Association is also dealing with the question of railway rates and risks in connection with consignment of goods, and a deputation has been appoined to wait on the Board of Trade, together with representatives from the Chamber of Commerce.

The representatives of the Association on the Engineering Standards Committee reported that good progress was being made in the standardisation of electrical apparatus and fittings generally, and at the request of the Sub-Committee, a further representative has been appointed to serve on the B.A. Screw Committee.

The Association having been consulted with reference to the better classification for Customs of electrical imports and exports, a Sub-Committee was appointed to deal with this question, and a report has been sent in to the Association.

In regard to the Benevolent Institution, Mr. W. Davenport, the secretary, reported that the sum of over £1,100 was at present invested, and that his Committee were taking active steps to promote the interest of what is apparently going to be a very useful branch of this Association.

It was felt that the further interests of the Association and its future usefulness would be materially improved by its various branches being dealt with in separate sections, and arrangements have already been made to form committees dealing with arc lamps, motor-starters, incandescent lamps, &c.

A proposal was brought forward at the meeting by the Committee, and was unanimously adopted, that, in view of the increasing usefulness of the Society, more spacious accommodation was required, and it was, therefore, decided to transfer the offices of the Association as from January 1st next to 2, Queen Anne's Gate, Westminster.

A vote of thanks was accorded to the secretary, Mr. Davenport, for his untiring services, and also to the chairman for presiding.

Parliamentary.—It was announced by the Prime Minister in the House of Commons on Friday last that the Supply of Electricity Bill would not be carried further this session, for want of time. Among the Bills which will be proceeded with is the Telegraph Construction Bill.

In the House of Lords on Tuesday Confirmation Bills for the following were read a second time:—Ardrossan, Saltcoats and District Tramways Order, the Dunfermline and District Tramways Order, and Dumbartonshire Tramways Order.

Military Electricians.—According to the *Western Morning News* of Plymouth, the regulations governing the selection of candidates for appointment as military mechanist electricians in the Royal Engineers have been revised, consequent on the withdrawal of submarine mining. Mechanist electricians are now formed by an amalgamation of the old list of mechanist electricians with the staff for military telegraphs, the amalgamation being effected by the transfer of all warrant officers and senior non-commissioned officers on the staff for military telegraphs to the mechanist list as electricians (for telegraphs). Any non-commissioned officers of the telegraph staff not included in the amalgamation are to remain supernumerary to the establishment, being considered for appointment to the mechanists' list as the vacancies occur. When all such supernumeraries are absorbed, the appointments as electricians will be by selection from a list of qualified candidates who have satisfactorily passed through courses of instruction at the School of Military Engineering, Chatham, and the Schools of Electric Lighting at Portsmouth and Plymouth.

"Candidates who satisfactorily pass will be considered in their order of merit for appointment on probation as vacancies occur. First appointment to mechanist or storekeeper carries the rank of staff-sergeant, with promotion to quartermaster-sergeant after six years' service. Promotion to warrant rank will in future be on an amalgamated list, to include all mechanists and storekeepers, but in selecting for the appointment of warrant officers due regard is to be given to individual service, so as to minimise any hardships due to such amalgamation. The examination of candidates for instruction as military mechanist electricians will be held as required at stations where there are applicants, and due notice is to be communicated to all stations by War Office circular. The next examination is to be held on April 9th. The examination papers will be prepared by the Instructor in Electricity School of Military Engineering, and will consist of two parts—a qualifying part, consisting solely of questions devoted to electrical matters of importance to defence, electric lighting, and electrical communications for coast defence, which are of a tolerably simple nature, so that electricians may reasonably be expected to know these with absolute accuracy; and a part intended to test a candidate's general knowledge of electrical matters generally. Candidates who successfully pass the examination will be considered for instruction as mechanist electricians, and will attend courses at Chatham, and be attached to K (Telegraph) Company, R.E., which works in conjunction with the General Post Office."

Institution Notes and Lectures.—CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—On Monday last the annual dinner of this Society was held at the Restaurant Frascati, the President, Mr. W. B. Esson, presiding. After the loyal toasts, Col. Crompton proposed the health of "The Society," remarking that, no matter how others fared, engineers at any rate were not decadent; they were having a good time, and they meant to have a good time in the future. Was there ever a time in the history of the world when so much was happening of surpassing interest? The meetings and discussions of societies greatly assisted progress, and he himself was founding a new society—the Institution of Automobile Engineering. Mr. Esson, who was one of his colleagues on the Engineering Standards Committee, had done a vast amount of work, and the process of thrashing out standard details in committee had been very beneficial to the members themselves.

In his reply, Mr. Esson referred to the work of the Hon. Sec., Mr. A. S. E. Ackermann, and remarked that the Society was "small and select"; its proceedings were informal, and the members, therefore, discussed engineering matters freely.

Prof. Perry proposed "Science and Engineering," defining an engineer as a man who could do what other people declared to be impossible. "Science" meant "knowledge," and, therefore, was not to be scoffed at. Practical engineering science was much more complex than laboratory science; both were necessary. Science should include the science of living and enjoying oneself as well as working. Mr. C. T. A. Hansen replied with an amusing account of a research in sanitary engineering, which he had involuntarily conducted at an early age. Votes of thanks followed. Various members contributed songs, recitations, &c., during the evening, and a very pleasant entertainment was the result.

The Royal Society.—At the meeting fixed for yesterday, the following papers were, among others, down to be read:—

Mr. F. W. Aston on "Experiments on the Length of the Cathode Dark Space with Varying Current Densities and Pressures in Different Gases." Communicated by Prof. J. H. Poynting, F.R.S.

Mr. E. Gold on "The Velocity of the Negative Ions in Flames." Communicated by Prof. H. A. Wilson, F.R.S.

Dr. T. H. Havelock on "The Electric or Magnetic Polarisation of a Thin Cylinder of Finite Length by a Uniform Field of Force." Communicated by Prof. J. Larmor.

Institution of Electrical Engineers (Glasgow Section).—At the meeting held on Tuesday last the adjourned discussion of the paper by Prof. F. G. Baily and W. S. H. Cleghorn on "Some Phenomena of Commutation" took place. A paper by Mr. H. B. Maxwell on "Fuel Economy" was to be read if time permitted, but the discussion was adjourned until the next meeting, on January 8th.

Bristol Association of Engineers.—At a meeting of this Association last Saturday, a paper was read by Mr. H. T. Sully, M.I.E.E., on "Meters for the Measurement of Electrical Energy for Electric Lighting and Power."

Royal Institution.—The Christmas course of lectures on "Signalling to a Distance—From Primitive Man to Radio-Telegraphy," adapted to a juvenile auditory, which is to be delivered by Mr. W. Duddell, will commence on December 27th, and continue on the 29th, and January 1st, 3rd, 5th and 8th.

Mr. Charles Bright, F.R.S.E., lectured at Eton College on December 8th, the subject being "Submarine Telegraphy."

Electric Shock Fatality.—A Glasgow paper reports that in the Coventry Ordnance Works at Scotstoun, John M'Kay, 24, an electrical engineer, while at his work on Wednesday afternoon last week caught hold of a live wire and was killed.

Appointment Vacant.—Assistant electrical engineer for Oban (£80).

F. W. Smith & Co., Ltd., v. Marshall & Crowther.—At the Liverpool Assizes on Thursday last week, Mr. Justice Lawrence gave judgment in an action in which plaintiffs, contractors, of Southport, claimed £250 from Thomas Shaw Marshall and John Crowther for work done and materials supplied under a document dated August 29th, 1904. According to a report in a Southport paper, his Lordship remarked that the Llandudno and Colwyn Bay Railway Co. held a provisional order for the construction of electric tramways. The contract for construction was given to the Welsh Electric Traction Co., who sublet it to the plaintiffs at £73,000, the work not to be commenced until £17,000, subsequently reduced to £8,000, had been deposited in the bank. The defendants, who were financiers, had entered into a contract with the Welsh Electric Traction Co. to finance the undertaking and they formed a limited liability company, the scheme being apparently to float debentures and obtain from the public the money required to make the railway. Matters stood in that position in August, 1904, the time when the work was to be commenced if the provisional order, which was about to expire, was to be made effective. The defendants had not found the £8,000, and the work had not been commenced, and the scheme would have collapsed if something had not been done. It was then that the document in question was signed by which the defendants undertook to pay the plaintiffs for all work done to an amount not exceeding £250. After consideration his Lordship had come to the conclusion that the document was not a guarantee as alleged by the defendants, but a direct promise to pay. From the defendants' point of view it was an exceedingly good bargain. They wanted to float the debentures, and they could not float them without getting out a prospectus, the issue of which would be of very little use unless they could point to something tangible ,being done. He (the judge) thought it a very dangerous thing to do, but he would assume that the defendants were honourable men, and that there was no intention to commit anything like a fraud on the public. His judgment was that the document was not a guarantee and that the plaintiffs were entitled to recover the £250 with costs. His Lordship added that, in his opinion, if the document were a guarantee there had been no release or discharge. Stay of execution was granted on the usual terms.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Engineers.—On Friday the Bradford Electricity Committee had under consideration the appointment of chief electrical engineer in succession to Mr. Blackman, who has accepted a similar appointment at Sunderland at a commencing salary of £800, rising to £1,000 in four years. The Council decided to recommend Mr. T. Roles, who has acted as deputy to Mr. Blackman since 1904. The commencing salary will be £450 per year for the first six months, rising to £500 a year, with annual increases of £50 to £700.

Mr. F. W. Hewitt has resigned his position as chief assistant in the electricity and tramways departments of the Darlington Corporation, in order to take up the position as assistant editor of the *Electrician*.

Out of over 300 applicants for the vacancy as assistant resident electrical engineer to the Stretford U.D.C., Mr. Ernest H. Rhodes, of Dalbeattie, N.B., was appointed at the last meeting of the Council.

Mr. J. Ainscough is leaving the service of the Kendal Corporation, and his address (*pro. tem.*) will be 351, Derby Street, Bolton.

On the occasion of his leaving Aberdeen to fill the position of electrical inspector to the National Boiler and General Insurance Co., Ltd., of Manchester, Mr. Eustace R. Conder was, on the night of the 5th inst., presented by his friends at the Corporation electricity works with an office tilting chair with suitable inscription. Mr. Bell, city electrical engineer, made the presentation, and conveyed to Mr. Conder, on behalf of the staff, wishes for every success in his new sphere of labour. Several other members of the staff having spoken in a similar vein, Mr. Conder feelingly replied.

Tramway Officials.—Mr. H. B. Harris, engineer of the Croydon Corporation tramways, was presented with a handsome liquor stand and a gong, by the engineering staff, on the occasion of their annual dinner on Saturday, December 8th.

General.—Mr. Douglas A. C. Bailey has been appointed electrical engineer to the Central Collieries, Wessel's Nek, Natal. His firm (Messrs. Jenkins & Co.) have been appointed agents for the "Pick-quick" coal-cutter, and, we understand, are the first to import and use them in South Africa.

Mr. E. D. Gledall, B.Sc., gave two interesting lectures and demonstrations in the Mechanics' Hall, Nottingham, on 23rd and 30th ult., on "Principles of Electric Wave Telegraphy." A large number of the employés of the National Telephone Co. were present at both lectures, together with the technical staff and management. Mr. Gledall, who was formerly engaged under the N.T. Co., is leaving England before Christmas to take up a position (under the British Government) connected with wireless telegraphy in South America, where he hopes to carry out a number of experiments in the tropics. He gave a dinner to the employés on 21st ult., and was on that occasion presented with a dressing case as a token of esteem.

According to the *Times*, Prof. J. J. Thomson, of Cambridge, on his arrival at Copenhagen on his way to Stockholm to receive his Nobel prize, said he would devote half of the prize to purposes of scientific research.

Mr. G. H. Oatway has resigned his position as a director of the May-Oatway Fire Appliances, Ltd, and will in future take no part in the management of the business.

Great Northern, Piccadilly and Brompton Railway.—On Wednesday last a Press inspection of the above railway was held, followed by a luncheon at the Criterion Restaurant. Sir George Gibb, in a brief speech, drew attention to the importance of this latest part of the great scheme of underground communication for London. In his opinion, differential fares were more favourable to the passenger and enabled the railway to compete with the 'bus over short distances; the new tube would offer many facilities in the way of interchange of traffic and through bookings, and its 3 minutes' service would prove a great attraction.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Benton, Keighley & Reynolds, Ltd. (electrical and general engineers, Fulham), (84,661).—Issue on November 16th of £500 5 per cent. debentures, part of series created same date, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital ranking in priority to previous issue. No trustees.

Frederick Braby & Co., Ltd. (metal workers, electrical appliances manufacturers, &c., London), (25,379).—Issue on October 31st of £5,300 4½ per cent. first mortgage debentures, part of series created September 21st, 1891, to secure £30,000, charged on the company's undertaking and property, present and future. No trustees. Previously issued of same series: £24,700. Also issue on October 31st, of £7,475 5 per cent. second mortgage debentures, part of series created May 13th, 1891, to secure £25,000, charged on the same property, subject to first debentures. No trustees. Previously issued of same series: £17,525.

CITY NOTES.

Cape Electric Tramways, Ltd.

In their report for the year ended June 30th, the directors state that the profit and loss account shows, after providing for debenture interest and redemption of debentures, a net balance to credit of

£5,269, which, added to the balance of £482 brought forward from last year, gives a total balance of £5,751. From this sum, the reserve fund has been credited with the amount of £4,000, and the balance £1,751, has been carried forward. During the year under review, the tramways carried in Cape Town 12,377,310 passengers, earning £147,716, against 15,020,503 passengers, earning £180,906 during the year 1904-5. In Port Elizabeth during the year under review, 3,905,536 passengers were carried, earning £42,857, against 4,227,576 passengers, earning £46,709 for the year 1904-5. The directors much regret that the above figures show so great a shrinkage in the tramway traffic in Cape Town and Port Elizabeth due to the great and notorious business depression still prevailing in every branch of commerce, without a single exception, throughout the whole of the Cape Colony, and, although the board hope the worst has been reached, there are, as yet, no definite signs that an upward tendency in general conditions of business has commenced. The lease of the Camps Bay Tramways, which this company held from the Cape Town Consolidated Tramways and Land Co., Ltd., came to an end on December 31st, 1905, and was not renewed. The diminished profits for the year under review include the loss shown on the working of these tramways for the six months from July 1st to December 31st, 1905. This factor is now removed from the balance-sheet, but the company still retain the advantage derived from the operation of the Camps Bay Tramways, which act as a feeder to their own lines. On October 25th, 1905, an extraordinary general meeting of shareholders was held, and a resolution was passed authorising the directors to create a "B" debenture issue of £200,000, bearing 5 per cent. interest per annum, and, in accordance with that resolution, an issue of "B" debentures of £150,000 was made, in debentures of £50 each, bearing interest at 5 per cent. per annum, the issue price being £90 per cent., which was fully taken up. The arbitration between the Cape Government and this company in regard to the amount to be paid by the former as compensation for the expropriation of the Sea Point Railway (the former property of this company) has not yet taken place, but it is anticipated that the whole business will be concluded before the end of December this year. The directors again desire to bear testimony to the services rendered by the Local Administration of the Sub-Companies in Cape Town and Port Elizabeth, and especially to the managers of these systems who have used their utmost efforts to protect the interests of the company during the most trying period under review. In accordance with the Articles, the remuneration of the directors is determined by the members in general meeting, but, having regard to the serious falling-off in the profits of the company, shareholders would not be called upon to vote anything in this respect for the past year, the directors having decided to forego their fees for that period.

Sir C. Euan Smith (Chairman) presided at the meeting held on Thursday, December 6th, at No. 1, London Wall Buildings, E.C. In moving the adoption of the report, he said that at the annual general meeting last year the hope was expressed by the board that the business depression existing at that time in Cape Colony had reached its worst, but, at the same time, the shareholders were clearly informed that according to their advices at that date, the position had not then improved, and the receipts still continued to show a falling off as compared with the corresponding period of the previous year. When the full figures of the traffic for the year ending June 30th last came before them, they found that the warning issued to the shareholders had been unfortunately justified. The gross receipts for the twelve months had been £147,715, as against £180,905 for the twelve months ending June 30th, 1905, or a difference of £33,190. Two important factors, irrespective of the general prevailing commercial depression, had greatly contributed to this unsatisfactory result. One was connected with grossly unfair competition. On December 1st, 1905, the Cape Government, who had previously taken possession of their Sea Point Railway in order to satisfy the Sea Point municipality and other people agitating to this end, opened the same to traffic; and ever since then they had, in co-operation with the Sea Point municipality, injured the company's legitimate business by establishing a ruinous and cut-throat competition. The Act which allowed this high-handed expropriation, could only be designated as an unwarranted attack on the rights which were originally granted to them by the Cape Assembly in accordance with the wishes of this same Sea Point municipality. It was, they thought, unparalleled in the annals of Colonial legislation. Their loss on this account alone would probably exceed the sum of £15,000 per annum, and as the railway itself was operated at a loss, which was, by agreement, to be refunded to the Government by the ratepayers of the Sea Point municipality, they could see that such unfair competition did not even benefit those for whose sake it was specially inaugurated. They were, moreover, compelled to occupy the humiliating position of having to contribute to the refund of the deficit by reason of their being ratepayers to the municipality. The whole matter had now been left to arbitration after they had received judgment in their favour in the Supreme Court in Cape Town. They could not but feel confident that they must be awarded a heavy sum in compensation for the great injury already done to their vested rights. The arbitration had been fixed to take place this month. The other factor concerned the diminution in the number of the travelling public in Cape Colony. It was estimated that for Cape Town alone, without taking into account their system at Port Elizabeth, from 20,000 to 27,000 people had left the Colony since the war, without any intention of returning. No words were needed to point out the directly injurious effect that this exodus must have had on their receipts. He was glad to say that during the 12 months under review the expenditure had been diminished by the sum of nearly £6,785, which might be looked on as foreshadowing further retrenchment. In their balance-sheet the Camps Bay Tramway Co. still figured as showing a loss of £10,919. This represented the result of the first six months' working of the three years' lease, which they held from the Cape Town Consolidated Tramways and Land Co., and which expired on December 31st last. The lease had been finally terminated, and the item would, therefore, be eliminated from their future balance-sheets. The total loss on this lease unfortunately amounted to £37,366, as shown in the company's accounts, but their company had received £25,637 for running rights, of which about £10,000 was clear profit. Lately, to meet the reduced spending power of the population they had instituted a system of 1d. fares for short distances within the municipal area of Cape Town, and this step had given proof that it was likely to be very popular. While the report was unpleasant and unsatisfactory, yet they were but common sufferers with every similar enterprise in South Africa. One consolation they had was that their systems were in a first-rate condition, and ready to take full advantage of the slightest improvement in the commercial situation as soon as there was the least sign of the arrival of better times.

Mr. L. Breitmeyer seconded the motion.

Mr. Lawson moved as an amendment—"That this meeting be adjourned till January 15th, and the report and accounts be referred to a committee of three independent shareholders, with instructions to ascertain the losses suffered by the company, and also the causes of the decline of the company's dividends from 16 per cent. in 1902 to *nil* in the past year." He charged the board with being absolutely ruled by Messrs. Wernher, Beit & Co., who held the debentures.

Mr. Parish, a late director of the company, also made a strong attack on the board, which, he said, was composed of the same gentlemen who practically ruined the Mexico Tramways. He contended that with proper management dividends could be paid.

Mr. Flint said he saw no signs of any dividend for years to come, and, in fact, they stood the chance of the debenture holders coming in and foreclosing.

Mr. Breitmeyer pointed out that their debentures were being paid off and would all be redeemed by 1926. He was convinced that the time was not long before they would again earn dividends of a moderate kind, but they could not expect to go back to 16 per cent.

The Chairman said the board could not accept the amendment, because everything had been fairly disclosed, and the reason why they were not successful was patent to anyone.

The amendment was rejected by a large majority, and the report adopted.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

The directors' report for the year ending September 30th, to be presented at the meeting next Tuesday, shows after provision for doubtful debts, a net profit of £37,221. Adding £55,003 brought forward, and deducting £12,500 interim dividend paid in June, there remains a disposable balance of £79,724. The directors recommend the distribution of a dividend of 15s. a share, free of income-tax, amounting to £37,500, making, with the interim dividend paid in June, a total payment of 10 per cent. for the year, and leaving £42,224 to be carried forward. The general business of the company shows a falling-off when compared with the results of the previous year. The prices of raw material remained at a high standard, yet a comparatively low range of selling prices was maintained by the trade generally in expectation of a fall in the former, which did not take place. The laying of the Shanghai-Manila cable, referred to in the last report, was completed in April. The cable steamers *Silvertown* and *Buccaneer* have been extensively overhauled. The works at Silvertown and at Persan have been maintained in their usual state of efficiency, and the electrical equipment of the latter, which is progressing satisfactorily, will probably be completed in 1907. The board regrets to announce the death, last month, of Mr. George Henderson, whose assistance and sound advice his colleagues greatly appreciated.

Adelaide Electric Supply Co., Ltd.

The directors' report for the year ended August 31st, 1906, states that with the sanction of the holders of the preference and ordinary shares, a further 5,000 preference shares were offered to the public for subscription in March last. The whole of the issue was subscribed and the shares have all been paid up in full. The cost of the issue, including underwriting, commission and advertising, was £1,614 9s. The directors recommend that a sum of £500 be written off this cost out of the profits, and that the balance be carried forward to be written off out of future profits. The profit and loss account shows a profit for the year of £9,124. After payment of the dividend on the preference shares, writing £500 off the cost of the issue of the 5,000 preference shares above referred to, and placing a sum of £1,000 to depreciation account, there remains an available balance of £6,297, which the directors recommend should be applied as follows:—Dividend on 15,000 6 per cent. preference shares for the half-year ended August 31st, 1906, £2,250; dividend of 2½ per cent. per annum on the ordinary shares for the year ended August 31st, £3,255; balance carried for-

ward, £792. During the year, a sum of £17,321 has been expended in Australia on capital account in providing additional buildings, plant and mains. Part of this expenditure was to enable Port Adelaide and the intervening suburbs to be supplied from the Adelaide station, with consequent increased economy and efficiency. It is expected that this work will be shortly completed. The company's mains have also been extended into some of the residential districts surrounding the City of Adelaide, from which additional revenue is anticipated. A table is given to illustrate the progress made at Adelaide during the past three years:—

Date.	Lighting in 8-c.p. lamps.	Motors in rated h.p.	Total equivalent connections expressed in 8-c.p. lamps.	Gross profit.
August, 1904	.. 28,502	654 h.p.	49,430	£4,828
August, 1905	.. 34,050	911 h.p.	63,202	£6,643
August, 1906	.. 39,396	1,119 h.p.	75,204	£9,506

Isle of Thanet Electric Tramways and Lighting Co.

Lord Arthur Butler (chairman) presided at Winchester House, on Tuesday, over the ordinary general meeting of this company.

In moving the adoption of the report (Elec. Rev., p. 925), the Chairman said he was glad there was some improvement over last year. In the profit and loss accounts, the receipts showed an improvement, both as regarded traffic and lighting—the former an increase of £172, and the latter an increase of £490. The electric light connections had increased from 13,800 8-c.p. lamps to 18,640 8-c.p. lamps, an increase of nearly 5,000. Taking the expenditure side, the total working expenses for the year amounted to £22,905, being £527 more than those of last year. The two principal items which made up these increases, were that of insurance caused by the enhanced terms which they had had to pay against third-party risks (£340), and the upkeep of rolling stock, which was higher by £330 this year. There was a slight increase under the heading of power station, salaries and wages, and a slight decrease in the repair of permanent way and in the coal bill. The shareholders could rely upon it that the utmost vigilance had been observed in keeping down expenses with due regard to the proper efficiency of working. The directors had last year waived half their fees The balance of profit carried to appropriation account was £12,449 6s. 3d. as against £12,815 18s. 11d. last year. After the various charges set out in that account had been paid a balance of £3,776 19s. 5d. had been transferred to the revenue account in the balance-sheet. With regard to the balance-sheet, the loans secured upon deposit of debenture stock were £50,000 instead of £52,000; £2,000 having been repaid out of revenue. The balance to revenue account brought forward was £1,047 0s. 2d. from which £272 2s. 6d. had been written off for rates suspense account. This was an account formed in connection with the question of the original over-assessment of the line. When the assesment was reduced the over-payment was placed to suspense. The local authorities of Margate and Broadstairs repaid the amounts, but Ramsgate refused. To prevent law costs, the board had not gone to the Courts, and to meet the auditors, the sum had been written off, but if it was repaid, it would be carried to the revenue of the year. The sum remaining for disposal was £4,251 17s. 1d., and it was decided to pay a three months' dividend on the preference shares, to place £2,000 to the reserve and renewals account, and to carry forward £376 17s. 1d. On the other side of the balance-sheet the only item which had materially altered was electric light installation, which had increased from £14,887 12s. 6d. to £16,034 14s. 6d. This increase represented capital expenditure in Margate and Broadstairs on connections, motors, &c., including the cost of installing the 4,800 extra lamps which he had referred to, and which had resulted in the increase of £490. They regretted that they were unable to pay the preference shareholders more, but it was perfectly obvious that provision must be made for carrying out the recommendation of the Board of Trade as to the reconstruction of the line at Madeira Hill at Ramsgate. It had been carried out at a cost of something like £1,500, and the work had caused some loss of traffic. He trusted, however, that the work would reassure the public, and give them increased receipts in the future. Some disappointment had been expressed that the traffic receipts were not larger in view of the fine weather in the summer and autumn. As a matter of fact, between October 1st of last year and July 31st of this year there was a falling-off of receipts amounting to £1,181, and this they made up in August and September. Comparing the figures of this year and last year they came out as follows:—Car-mileage, 749,261 in 1906, as compared with 787,209 in 1905; passengers carried 4,388,292, against 4,389,038; traffic receipts per car-mile 10·32d., against 9·77d.; traffic receipts £32,254, against £32,081; lighting receipts £3,272, against £2,781; total receipts £35,854, against £35,194; working expenses £22,905, against £22,378; gross profit £12,949, against £12,816; percentage of working expenses to receipts 63·88, against 63·58.

Mr. H. C. Levis seconded the motion.

Messrs. Palmer, Yates and other shareholders severely criticised the non-success of the company, which they considered was inefficiently managed. It was pointed out that the payment of £2,000 to the insurance company was a very big drain on the company.

The Chairman, in reply, said the board were considering the question of insurance, and if they went on all right, they would get a substantial decrease in their premium. The fact was that their district was an exceptional one, and they never anticipated that with three towns of the size of Margate, Broadstairs and Ramsgate there would be practically a dearth of traffic in the winter.

The report was adopted.

Lancashire Power Construction Co., Ltd.—The report for the fifteen months ended December 31st last (as published in the *Financial Times*) states that in October, 1905, delivery of current from the station at Radcliffe to customers was commenced, and at the date of this report 12 customers were being supplied with energy, and others were in process of connection to the company's mains. It is anticipated that the income to be derived from the consumers now connected and in course of connection will be sufficient to provide for all running costs incurred at the station and for a large proportion of head office expenses chargeable to revenue. During 1906 the Lancashire Electric Power Co. obtained an Act giving them (*inter alia*) further facilities for dealing with consumers; and active negotiations are now proceeding with various local authorities to enable the Power Co. to supply direct to power users in the authorities' areas. These negotiations give promise of a successful conclusion. In the case of Swinton and Pendlebury, an agreement with the Council has been sealed for giving a bulk supply and authorising this company to supply power upon certain conditions to consumers within the district. The whole of the "A" shares have now been paid up, and 10,336 "B" shares have been applied for and paid in full. Of these 10,152 have been allotted, and the balance will be allotted in due course. In addition to the 1,664 "B" shares yet to be taken up by the contractors, further capital will be necessary to complete the undertaking, and to carry out works not contemplated in the original scheme in connection with provisional orders of which the Lancashire Power Co. propose to take transfers, and for other purposes. Arrangements have been made to provide temporarily the funds necessary for the present.

Stock Exchange Notices.—Application has been made to the Committee to appoint a special settling day in and to grant a quotation to—

Mabira Forest (Uganda) Rubber Co., Ltd.—95,000 shares of £1 each, 10s. paid, Nos. 1 to 1,002 and 26,003 to 120,000.

And to appoint a special settling day in—

Cascade (1906) Power Co., Ltd.—52,262 shares of £1 each, fully paid, Nos. 1 to 52,262: and £499,755 4 per cent. debenture stock.

Manx Electric Railway Co., Ltd.—At this company's meeting on Tuesday, Mr. A. Boscawen, who presided, said that the year's receipts were £34,279, as compared with £32,638 in the previous year, and the ordinary working expenses £15,756, as against £15,325. The cost of the Snaefell accident was £2,003. Out of the net revenue of £18,724 they had paid debenture interest and one-half of their preference interest, the remaining half would be paid immediately, £1,500 was placed to reserve for special renewals and £1,269 was carried forward. Taking into consideration the special expenditure, which included the cost of the accident mentioned, the directors were convinced that they were pursuing the proper course in not paying a dividend on the ordinary shares.

Provincial Tramways Co., Ltd.—The report for the year ended September 30th, states that the net revenue received from the local companies has been £30,992, against £24,050 last year. After setting aside £9,000 for depreciation, the directors now recommend a dividend of 4s. 6d. per share, making 7s. 6d. per share on the ordinary shares for the year. During the year the system has been improved in several respects by arrangement with the local authorities. The Cleethorpes District Council having given notice that they desired to exercise their right of purchasing the company's power station, the negotiations as to the price have been brought to a satisfactory conclusion, but it has been arranged that the company shall retain possession of the station for a period of five or seven years from 1905, at the option of the local authority. The directors propose to apply to the Light Railway Commissioners for an order authorising a short extension of the Portsdown and Horndean line and for making provisions for the better working of the undertaking. Diesel oil engines have been installed for the generation of electric energy at the station at Purbrook and are working satisfactorily; they have greatly reduced the cost of motive power since the close of the financial year. The greater part of the Gosport and Fareham system was opened for traffic in January last, and a further section has been opened since the close of the financial year. The question of writing off lost capital is still under consideration. In order to discharge the liabilities upon capital account, the directors have created £150,000 of first debentures (4½ per cent.), such debentures to be offered to the shareholders in the first instance.

Prospectus.—*Mansfield and District Tramways, Ltd.*—Subscriptions are being invited for 42,767 6 per cent. cumulative preference shares of £1 each, 14,818 ordinary shares of £1 each, and £50,000 of 4½ per cent. mortgage debenture stock of this company, which has been formed to acquire the authorised mortgages and share capital of the Mansfield and District Light Railway Co.

San Paulo Tramway, Light and Power Co., Ltd.—A quarterly dividend of 2 per cent. is announced.

United Electric Tramways of Monte Video, Ltd.—An interim dividend at the rate of 6 per cent. per annum on the preference shares for the half-year to September 30th has been declared.

Eastern Telegraph Co., Ltd.—An interim dividend of 1¼ per cent. on the ordinary stock for the quarter ending September last, is declared.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—An interim dividend of 2s. 6d. per share, is announced, for the quarter ending September last.

MARKET QUOTATIONS.

Wednesday, December 12th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Benzole (90 %)	per gal.	10½d.	..
a ,, (50 %)	per gal.	1/-	..
a Copper Sulphate	per ton	£31 10	..
a Lead, Nitrate	per ton	£31	..
a ,, White Sugar	per ton	£35	..
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160°C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a Potassium Cyanide	per lb.	8½d.	..
a Shellac	per cwt.	220/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a ,, Cyanide	per lb.	7½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£200	..
b ,, Wire, in ton lots	per ton	£220	..
b ,, Sheet, in ton lots	per ton	£210	..
p Babbitt's metal ingots	per ton	£62 to £207	..
c Brass (rolled metal 2° to 12°) basis	per lb.	11½d.	..
c ,, Tube (brazed)	per lb.	1/0½	½d. inc.
c ,, ,, (solid drawn)	per lb.	11½d.	½d. inc.
c ,, Wire, basis	per lb.	11d.	..
c Copper Tubes (brazed)	per lb.	1/2½	..
c ,, ,, (solid drawn)	per lb.	1/2½	..
g Copper Bars (best selected)	per ton	£121	£4 inc.
g Copper Sheet	per ton	£121	£4 inc.
g ,, Rod	per ton	£121	£4 inc.
e ,, (Electrolytic) Bars	per ton	£109	50/- inc.
e ,, ,, Sheets	per ton	£121	40/- inc.
e ,, ,, Rod	per ton	£113	60/- inc.
e ,, ,, H.C. Wire	per lb.	1/1¼	¼d. inc.
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/8	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/0 to 5/2	dec.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	62/11	2/9½ inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£19 12 6 to £19 15	..
g ,, ,, Sheet	per ton	£21 2 6 to £21 5	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/4 to 1/6	..
p ,, rolled bars & rods	per lb.	1/5 to 1/6	..
p ,, ,, strip & sheet	per lb.	1/5½ to 1/9	..
o Platinum	per oz.	nominal	..
e Silicium Bronze Wire	per lb.	1/2⅔	½d. inc.
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block (English)	per ton	£197 to £198	£1 dec.
n ,, Wire, Nos. 1 to 16	per lb.	2/4	..
p White Anti-friction Metals— "White Ant" brand	per ton	£61 to £88	£1 dec.
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£31 15	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Switchgear Specification.—A correspondent has drawn our attention to the payment clause in the specification for switchgear for Bray. The retention money (12 months) amounts to 50 per cent. of the total, and no payment whatever is made until after the engineer has certified the plant as having been erected complete to his satisfaction, and as having passed the final tests.

This is certainly an exceptionally stringent requirement. Were all engineering work carried out on the same lines, business would necessarily come to a standstill. As it is, manufacturers are severely handicapped when dealing with municipalities by the inconsiderate manner in which payments are delayed, even after they have been certified by the engineers. Payments should commence with the delivery of the goods, and not more than 20 per cent. at the utmost should be retained after completion, unless the contact is a very small one.

STOCKS AND SHARES.

Tuesday Evening.

Having entered upon the final settlement of the year, it is not to be expected that the Stock Exchange will be very busy between now and 1907. Christmastide provides the markets with plenty of scope for charity and joviality: it is only outside the Stock Exchange that soured and gloomy misanthropes may occasionally be found who profess hatred of the season. But, as we observed last week, prices are too generally inclined to fall away at this time of year, because of money stringency, and the present month is cleaving to the usual rule, so far as the electrical markets are concerned.

From which generalising, it is not inappropriate to pass to the definite case of the Telegraph market. Here, a long list of falls is an unpleasant feature. The Eastern division has again been the subject of attack, and Eastern Extension shares at 13 are 12s. 6d. down, equivalent to a drop of 6¼ points in stock. Eastern Telegraph Ordinary has lost three more points, making the price 133½, and the company's senior issues are both lower. Indo-Europeans and Great Northerns each lost 10s.; the Anglo-American Telegraph trio has relapsed, and District United States shares are 5s. easier. The fall spread to Western Telegraphs, and all the share issues of the West India and Panama Company have been put down. Globe Ordinary dropped ⅜ to 10¼ and the Preference ¼ to 14¼ upon this strange outbreak of nervousness amongst telegraph securities. Frankly, we are at a loss to explain the movement as due to any other cause beyond the prevailing dulness of investment departments as a whole, due to the dearness of money, and the impartial nature of the fall confirms this view as being at all events approximately correct.

National Telephone Preferred stock has eased off 10s., and so has the company's Second Preference shares. Marconi's, too, are $\frac{1}{16}$ lower.

There is this negative consolation in writing about electric lighting shares to-night, especially after enumerating the melancholy falls in telegraph issues: the former show comparatively little loss on the week. There is a decline of ¼ to 4¼ in Urban Preference, and of a similar fraction in County Ordinary to £8, while Metropolitan Preference slipped back $\frac{1}{16}$ to 5¼. Newcastle-on-Tyne new Ordinary are quoted at 3 and the new Preference at 2¼. The manufacturing companies are steady, as regards quotations.

Dealers in the electricity supply section admit that all hope of any decided movement in their market must be abandoned until some arrangement has been reached between the warring interests at work upon the various schemes for supplying the metropolis with power. Business in the shares has fallen to an ebb as relatively low as the prices, and there is no present prospect of revival in either.

While the manufacturing shares connected with the supply market are steady, those linked with the telegraph industry have a tendency to droop, along with prices in the telegraph department itself. Henley's are 10s. down at 11½, and Telegraph Constructions £1 lower at 31. Other industrials call for no particular notice beyond British Aluminium Ordinary shares, which are 5s. up at $5\frac{15}{16}$.

Railway issues should be well to the fore in the matter of commanding public interest, but for reasons connected with money (we are beginning to get more than a little tired of money) the market is neglected still. Not a solitary change has occurred in the prices quoted on the next page, but Metropolitan fell a point to 63½, Districts remaining at 20½. Baker Street and Waterloo Debenture has firmed up to 97 upon the better business which the line is doing, and upon the prospects opened up by the development of the London Tubes system. The shares of the Great Northern, Piccadilly and Brompton are nominally 7-8 for the £10 fully-paid Ordinary; the line, of course, is expected to open to-morrow. The company's 4 per cent. Debenture stock changed hands at 91¼ on Monday, and the same class of stock in the twin-concern —the Charing Cross, Euston and Hampstead Railway—is about 88½.

Concerning traction varieties, little need be said. British Electric Second Debenture has added a point, the shares not altering. Anglo-Argentine Preference were rather extensively offered, and the price reflects this with a fall of $\frac{5}{16}$ to 5$\frac{11}{16}$. Cape Electrics lost their slight advance of a week ago, and with this the tale of fluctuations comes to an end.

Canals and Waterways.—The Royal Commission has issued an interim report including the evidence taken up to August. A coloured map is given, showing the canals of the United Kingdom, which amount in all to about 4,048 miles, of all sorts and sizes.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Dec. 4th.	Closing Quotations Dec. 11th.	Business done week ended Dec. 11th, 1906. Highest.	Lowest.	Rise + or Fall −
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3½ — 3⅝	3 — 3½	..	..	— ¼
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	88 — 93	84 — 93	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	23/6	31/6	66½ — 68½	66½ — 68½	66⅝	..	..
5,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅝ %	6 %	109⅜ —110⅜	109 —110	110½	109	..
5,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	½ %	27⅞ — 27⅞	26⅞ — 26⅞	27 15/16	26½	— ⅜
60,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	102 —104	102 —104	102⅜	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	6⅞ — 7¼	6⅞ — 7¼	..	..	..
1,922,856£	Commercial Cable Sting. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	97⅛	97	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %	8¼ — 9	8¼ — 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9 — 9½	9 — 9½	..	..	..
80,000	Do. do. 4½ % Debs.	20	4½%	4½%	4½%	4½%	99 —101	100 —103	..	..	+1½
60,710£	Direct United States Cable	20	5¼%	8 %	8¼%	4½%	15⅝ — 16¼	15½ — 16	15⅞	15⅝	— ½
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	135 —138	132 —135	136½	133	—3
2,000,000	Do. 5½ % Pref. Stock	100	5½%	5½%	5½%	5½%	90 — 92	89 — 91	91	89	—1
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	105¼ —107½	105 —107	106⅜	105	— ½
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	136⅜ — 136⅝	123⅜ — 131⅜	135/32	122/4	— ⅜
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105¼ —107½	105¼ —107½	..	..	..
500,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 5,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99 —101	99 —101	99½	..	..
180,887	Globe Telegraph and Trust	10	£3	5¼%	5⅜%	5½%	10½ — 10⅝	10 — 10½	10⅜	10¼	— ⅜
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅝ — 14¾	14 — 14½	14⅜	..	— ¼
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	86 — 88	85½ — 85½	86½	86¼	— 2
87,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	100½ —102½	100½ —102½	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	13 %	58½ — 60½	58 — 60	58½	58	— ½
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1 1/16 — 1 1/16	1 — 1⅛	1 1/16	..	— 1/16
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	8 %	8 %	4 %	5 %	⅞ — 1	⅞ — 1	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅞ — 1	⅞ — 1	..	..	..
1,988,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107½ —109½	107½ —109½	108⅝	108½	— ½
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	107 —109	106½ —108½	108½	107	— ½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	12 3/32	11½	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½ — 12½	10 — 12	..	..	— ½
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5¼ — 5½	5¼ — 5½	5⅝	5 5/16	..
2,000,000	Do. do. 5½ % Deb. Stock Red. ..	Stock	5½%	5½%	5½%	5½%	97 — 99	96 — 98	97⅛	97⅜	—1
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —104	100½ —102½	..	..	—1
179,818	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½%	6½%	7½%	1½ — 1⅝	1 1/16 — 1⅛	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅛ — 1½	1⅛ — 1½	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,889£	Reuter's	8	5 %	5 %	5 %	5 %	7¼ — 7⅜	7¼ — 7⅜	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	101 —104	101 —104	..	..	..
8,201	Submarine Cables Trust	Certs.	6 %	6 %	6 %	6 %	126 —129	126 —129	..	..	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	6⅞ — 7⅜	6⅞ — 7⅜	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼ — 5½	5¼ — 5½	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —113	110 —113	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	10 — 10⅛ xd	10 — 10⅛	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	1/16	..	— 1/16
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100½ —103½	100½ —103½	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	14 — 14½	13⅝ — 14	13⅝	13⅜	— ⅛
568,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜ — ½	5/16 — 7/16	11/6	11/3	— 1/16
34,568	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	7⅛ — 8	7⅛ — 7⅞	7¼	..	— ⅛
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	5¼ — 6¼	5¼ — 6¼	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	101 —104	101 —104	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	..	8 %	8 %	7 7/16 — 7 11/16	7 7/16 — 7 15/16	7⅞	7½	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅜ — 6	5 5/16 — 5 13/16	5 13/16	5⅝	— 1/16
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	139 —142	139 —142	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	..	..	..
800,000	Babcock & Wilcox, 1 to 580,000	1	..	17 %	20 %	20 %	3⅞ — 4⅛	3⅞ — 4⅛	80/7½	79/6	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	5 1/16 — 5 1/8	5 1/16 — 6 1/16	5 7/32	5⅛	+ ⅛
40,000	Do. do. 7 % Cum. Pref..	5	Nil	Nil	7 %	7 %	6¼ — 6¾	6¼ — 6¾	6⅜	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼ — 5¾	6¼ — 5¾	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4¼	4 — 4¼	..	..	..
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	101 —105	101 —105	..	..	..
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	..	100 —103	100 —103	..	..	..
800,000	British Columbia E. Rail Def. Ord. Stock ..	100	..	6 %	6 %	6 %	127 —132	127 —132	129½	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	108 —112 xd	108 —112	111½	110⅜	..
115,000	Do. 5 % Cum. Perp. Pref. Stock ..	100	..	5 %	5 %	5 %	108 —111	108 —111	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
188,301	British Electric Traction	10	8 %	6 %	6 %	3 %	4½ — 4⅝	4½ — 4⅝	92/6	86/3	..
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	8¼ — 8⅝	8¼ — 8⅝	8⅝	8½	..
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	105 —109	107 —110	107¼	..	+1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	85 — 88	85 — 88	85	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6⅝ — 6¾	6⅝ — 6¾	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	94 — 98	94 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1 — 1½	1½ — 1¾	..	..	+ ¼
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝ — ¾	⅝ — ¾	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	2½%	¾ — 1	¾ — 1	16/10½	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1¼ — 1⅜	1¼ — 1⅜	19/4½	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	95 — 97	95 — 97	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 85	82 — 85	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3 — 3⅛	3 — 3⅛	64/4½	62/6	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..
817,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	105 —107	105 —107	106	105½	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	7⅞ — 8⅜	7⅞ — 8⅜	8	..	..
82,610	Do. 105,001 to 187,610	5	..	..	..	8 %	7⅞ — 8⅛	7⅞ — 8⅛	7⅞	..	..
29,330	Do. 5 % Cum. Pref., Nos. 1 to 29,330	..	..	..	..	..	5¼ — 5⅜	5¼ — 5⅜	5 5/32	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	104	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	9¼ — 10⅛	9¼ — 10⅛	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	103½ —110½	103½ —110½	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	15 %	10 %	5 %	Nil	3/32 — 1/8	1/16 — 1/8	10/3	10/-	— ⅛
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/16	23/1½	..	..
280,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	100½	100	..
1,989,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	83 — 85	83 — 85	83¼	..	..
630,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..
630,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	72 — 75	72 — 75	..	..	..
1,480,000	City and South London Railway	Stock	3½%	2⅜%	2⅜%	1⅞%	41 — 43	41 — 43	..	..	..
85,000	Crompton & Co., Nos. 1 to 85,000	£	5 %	2½%	2½%	2½%	1½ — 1⅝	1½ — 1⅝	..	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	94 — 97	94 — 97	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Dec. 4th.	Closing Quotations Dec. 11th.	Business done week ended Dec. 11th, 1906.		Rise + or Fall—
		†	1902.	1903.	1904.	1905.			Highest.	Lowest.	
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	..	10 %	10 %	1 7/16 — 1 1/8	1 7/16 — 1 1/8	..	..	..
805,000	Do. do. 6 % Cum. Pref., 1 to 805,000	1	..	6 %	6 %	6 %	1 1/8 — 1 1/4	1 1/8 — 1 1/4	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5⅝%	6 %	6 %	14 — 15	14 — 15	14½	..	..
59,987	Do. 6% Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½%	4⅓%	1⅝ — 1¾	2 1/16 — 2 1/8	30/	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½%	4⅓%	2 1/16 — 2 1/8	2 1/16 — 2 1/8	..	..	..
844,028‡	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	7 %	1½ — 2	1½ — 2	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	83 — 86	83 — 86	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	9 — 9½	9 — 9½	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	8¼ — 8¾	9¼ — 9¾	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½ — 10¾	10¼ — 10¾	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —103	102 —103	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	11½ — 12¼	11 — 12	..	..	— ½
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 7/16 — 5 9/16	5 5/16 — 5 9/16	..	..	..
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108 xd	..	..	..
60,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17½	17	..
87,500	†Liverpool Overhead Railway, Ord.	10	1⅛%	1⅜%	1½%	Nil	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6 — 7	6 — 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8 — 8¼	8¾ — 9	..	..	+ ⅜
399,980	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	3 %	8¼ — 4½	5½ — 4½	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8 — 9	8 — 9	8½	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	90 — 95	90 — 95	..	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Ni	Nil	Nil	3 %	1/16 — 1/8	1/16 — 1/8	1/9	..	— 1/72
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/8 — 1/16	3/32 — 1/32	16/3	..	— 1/72
850,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	97 —100	97 —100	..	..	..
150,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	..	6 %	6 %	4 3/16 — 5	4 1/16 — 4 1/8	..	..	— 1/16
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6 — 7	6 — 7	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7½ — 8½	7½ — 8½	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	98½ —101½	98½ —101½	..	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	31 — 33	30 — 32	32	30½	— 2
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	..	5 %	8½ — 91	8½ — 91	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	100 —103	100 —103	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8½ %	3 %	Nil	Nil	1 — 1½	1 — 1½	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	2½ — 3	2½ — 3	..	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	73 — 76 xd	73 — 78 xd	75	73	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5⅓%	4 7/9%	5 — 5½	5 — 5½	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	99 —101	99 —101	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8½ — 8¾	8½ — 8¾	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅞ — 8	7⅞ — 8	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	100 —103 xd	100 —103	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	3½ — 4¼	5½ — 4¼	78/9	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4¼ — 4⅝	4¼ — 4⅝	..	..	..
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅝ — 4¼	3⅝ — 4¼	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5⅛%	6 %	6 %	5⅝ — 5⅞	5⅛ — 5⅞	..	..	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	9¾ — 10⅛	9¾ — 10⅛	9⅞	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 — 12	11 — 12	11⅞	..	..
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	..	..	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2⅛ — 3⅜	2⅛ — 3⅜	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅜	5 — 5⅜	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8 — 8½	7⅞ — 8¼	7⅞	..	— ¼
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 11⅛	10⅜ — 11⅛	10⅞	..	..
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	..	..	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	2⅜ — 3½	2⅜ — 3½	..	..	..
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	4½ — 5½	4½ — 5½	99/4½	..	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5⅛%	5⅛%	5⅛%	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
10,000	Do. 6 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	4⅛ — 5⅜	4⅛ — 5⅜	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
18,000	Hove, 1 to 18,000	5	..	8½%	8½%	9 %	7⅜ — 8½	7⅜ — 8½	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½	12 %	10 %	9½ — 10½	9½ — 10½	9⅝	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	1⅜ — 2½	1⅜ — 2½	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4½ — 5½	4½ — 5½	5⅛	97/6	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	7⅜ — 8⅛	7⅜ — 8⅛	8	..	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅞ — 5 7/8	5⅛ — 5⅝	..	..	— 1/16
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	..	..	..
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅞ — 8	7⅞ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13½ — 14½	13½ — 14½	13 9/16	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6⅜ — 6½	6 — 6½	..	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	9½ — 10½	9½ — 10½	10	9½	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	1½ — 2½	1½ — 2½	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½	8 %	4 %	4 %	2⅜ — 3⅛	2⅜ — 3⅛	..	..	..
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	Nil	2½%	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..
117,968	Do. Do. 7 % Pref.	1	Nil	7 %	7 %	7 %	1⅜ — 1 7/8	1⅜ — 1⅝	25/8	..	— 1/16
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3⅛ — 3⅝	3⅛ — 3⅝	..	..	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4¼ — 4½	4 — 4½	86/10½	..	— ½
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	9 — 10	9 — 10	9 1/16	..	..
23,151	Do do. 4½ % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅝	5⅛ — 5⅝	5 1/16	5 5/16	..
	(Originally 5%—Red. to 4½ % from 31st Dec., 1905.										

Shares not officially quoted:—Mackay Companies, ord., 75—77. Pref. 71—73.

† Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

(Bank rate of discount 6 per cent. October 19th. 1906.

THE SIEMENS-SCHUCKERT SINGLE-PHASE SERIES MOTOR.

In a recent number of the *E.T.Z.* Dr. Rudolf Richter gives a detailed account of certain improvements in the design and construction of the single-phase series motors made by the Siemens-Schuckert Werke, from which we take the following particulars.

The motor is a compensated series one, and differs from other makes chiefly in two points, viz., the arrangement of the resistances in the commutator connections and the arrangement of the compensating windings.

As is well known, the only really satisfactory cure for sparking and heating at the brushes when starting consists

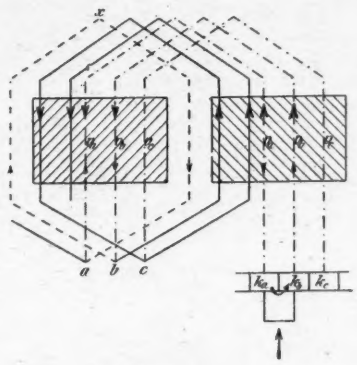


Fig. 1.

in the introduction of resistances between the armature winding and the commutator segments. So long as the starting power of the motor is not of special importance Messrs. Siemens, in common with most other makers, insert this resistance in the form of thin strips of high resistance metal placed behind the commutator. When, however, the starting torque is of importance, as in the case of all traction work, Messrs. Siemens introduce the resistance in the form of a certain number of turns of copper

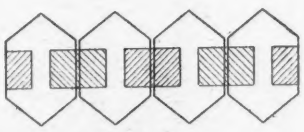


Fig. 2.

wire placed in the armature slots with the main winding of the machine, and arranged to act as active conductors during commutation. Fig. 1 shows the connections. The dotted coil $a\ x\ b$ of the main winding is undergoing com-

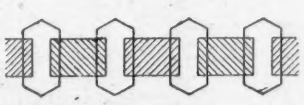


Fig. 3.

mutation, and its ends a and b are connected to the commutator through the "auxiliary" coils v_a and v_b. The main current of the motor enters the brush and flows into the two commutator segments k_a and k_b in parallel, along the auxiliary coils v_a and v_b and into the main winding at a and b, as shown by the large arrows. The short-circuit current produced by the transformer action of the main poles is shown by the small arrows, and travels from a along the auxiliary coil v_a, across the brush from k_a to k_b, along v_b to b, and so through the short-circuited main coil $b\ x\ a$ to a. The auxiliary coils are situated, as shown, right under the poles, and the main current flowing in them consequently produces a useful torque just as in any of the main winding coils. The auxiliary coils being situated in a neutral zone cannot affect the main field, and being, as regards the short-circuit current, practically wound bifilarly, they hardly add to the inductance of the short circuit. The value of the short-circuit current at standstill can be limited to any desired amount by making the auxiliary coils of suitable resistance, and, since the auxiliary coils act as active turns, it is obviously advisable to make them of low resistance material, such as copper, and so to get the benefit of a large number of turns for a given resistance.

The arrangement recalls the Sayers armature winding, but, in the present case, neighbouring sides of auxiliary coils have equal voltages induced in them, whilst with Sayers's arrangement these voltages were unequal. Further, reversal of direction of rotation necessitated brush shifting with the Sayers winding, whilst with the Siemens winding the brush position is the same for both directions of rotation.

Various alternative arrangements of the auxiliary coils are described, including one in which the span of these coils, instead of being made equal to the pole pitch (as in fig. 2), is made only a little wider than the neutral zone between neighbouring poles (as in fig. 3). In this way the length of the useless end connections for these coils is reduced, and also their reactance voltage is reduced by the fact that auxiliary coils belonging to neighbouring sets of brushes lie well separated on the periphery instead of being in the same slot.

If u is the ratio of the active ampere conductors in the auxiliary and the main windings, and if uniform flux density over the pole face is assumed, the useful output with the auxiliary winding fitted will be $(1 + u)$ times that with the ordinary winding and resistances — the total losses being alike in both cases. If η is the efficiency with the ordinary winding, the efficiency with the new winding can be shown to be $\frac{1 + u}{1 + u\,\eta} \times \eta$, or approximately $\{1 + u(1 - \eta)\}\eta$. Supposing, therefore, that a particular motor had an efficiency of 80 per cent., and that u were made ·1 (which is a normal figure, and in the case of machines intended for heavy starting conditions can easily be increased to ·2) the output with auxiliary windings would be increased 10 per cent., and the efficiency about 1½ per cent.

With such small differences it is difficult to obtain exact experimental confirmation, but by testing two armatures—one with and one without the auxiliary winding—in the same field, the fact that the auxiliary winding reduced the current required for a given starting or running torque was clearly brought out.

The author proceeds to show that the auxiliary winding adds very little to the reactance voltage of the machine, and calculates that, for a particular motor having $u = ·1$, number of commutator segments = 115, number of poles 6, $\frac{\text{pole breadth}}{\text{pole pitch}} = ·62$, and $\frac{\text{brush width}}{\text{segment width}} = 2$, the addition to the reactance voltage is under 10 per cent.*

Starting and regulation of the Siemens-Schuckert motor are accomplished by means of a variable secondary voltage transformer of the full motor capacity. With this arrangement a terminal voltage equal only to the full load inductive drop of the motor is applied at starting, and this passes the normal full load current and gives the normal full load torque with a greatly reduced line current. Thus, if the full load power factor of the motor is ·9, the line current for normal starting torque is only $\frac{\sqrt{1 - ·9^2}}{1} = ·435$ of the normal full load running current.

Turning next to the arrangements adopted for compensation and commutation, some further novel points will be noticed. The object of the compensating winding is the complete suppression of the armature cross field; whilst the

* Dr. Eichberg, in a criticism of the article, points out that with the more usual values of number of commutator segments = 200, pole breadth/pole pitch = ·85, and brush width/segment width = 1·8, the addition to the reactance voltage would be approximately 87 per cent., in place of the above 10 per cent.

reversing winding or poles should counteract (1) the voltage induced in the short-circuited coils by the transformer action of the main field; and (2) the ordinary reactance voltage which exists as in the case of a direct-current machine. Now to counteract (1) completely involves the use of an opposing and equal transformer flux, but all attempts to introduce this have failed because the same flux which counteracts the transformer action reduces the working torque of the motor to zero. It only remains, therefore, to counteract the transformer action more or less completely by the same means as are used to neutralise the reactance voltage, viz., by a voltage of rotation set up by means of a suitable cross field. One of the chief difficulties lies in the fact that, whilst the reactance

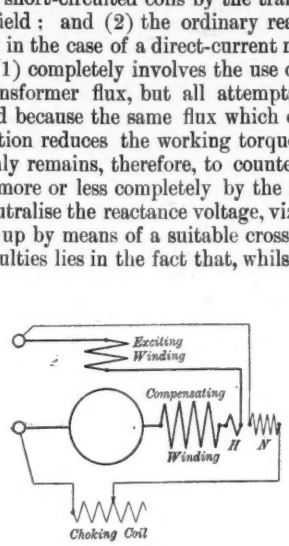


Fig. 4.

voltage is in phase with the armature current, and can be neutralised by means of a flux in direct opposition of phase to this current, the transformer voltage is at 90° to the main flux (or armature current) and therefore requires a flux at 90° to the main flux. For satisfactory commutation it is, therefore, necessary to produce a reversing flux which shall have a phase relation somewhere between 180° and 90° to the main current—nearer to 90° or 180° according as the transformer voltage or the reactance voltage is the greater. Now the transformer voltage varies in amount practically directly with the motor current (or flux) independently of the speed, whilst the reactance voltage depends on the product of current by speed, and, since the speed of a series motor is almost inversely proportional to the current, this voltage is almost constant in amount. It is, therefore, necessary to compensate each of these voltages separately. This end is attained in the Siemens-Schuckert motor by the use of two windings on the reversing poles—one being the ordinary series winding, which produces a flux proportional to the motor current, and is therefore suitable for counteracting the reactance voltage, and the other a shunt winding (carrying from

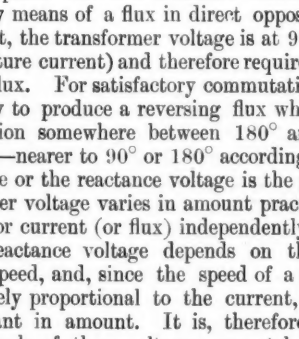


Fig. 5.

1 per cent. to 5 per cent. of the full load current), connected either across the motor terminals, or, better, across the brushes, and setting up a flux at approximately 90° to the main current. In this way complete automatic counteraction of the reactance voltage can be produced, but the compensation for the transformer voltage will only be correct at one particular load, and more or less incomplete at other loads. For compensation at all loads the voltage applied to the shunt winding must be varied by hand, and this variation will be less the more the iron is saturated.

The arrangement of the windings can be either as shown in fig. 4 or as in fig. 5, the latter being arranged for hand regulation of the shunt voltage. It will be seen that four field windings are shown:—(1) The main exciting winding, (2) the compensating winding, (3) the series winding, H, of the reversing pole, and (4) the shunt winding, N, of the reversing pole. In practice (2) and (3) are, of course, combined. In order to allow each of the reversing magnet fluxes to vary independently without appreciable interaction, the ingenious arrangement shown diagrammatically in fig. 6 is adopted. This diagram represents a portion of the neutral zone of a motor without salient poles.* The thin shunt-winding of the reversing pole surrounds some three teeth, whilst the series winding of the reversing pole is arranged as shown by the thick lines, so as to complete its magnetic circuit *within* the shunt winding. The flux set up by the shunt winding follows the thin dotted lines and that of the series winding the thick dotted lines. It will be seen that the middle tooth, which acts as the reversing pole, carries both fluxes, and yet both can vary practically independently, which would not be the case if both windings surrounded the same pole as usual. This independence of action is increased if a choking coil is inserted in the shunt circuit as shown in fig. 4. It may be pointed out that in order to neutralise the transformer voltage at every instant, the shape of the cross flux curve, with regard to time, must be the same as that of the transformer voltage curve, and this will only be the case if the supply voltage is sinusoidal. In order to reverse the direction of rotation of a motor compensated as above, it is only necessary to reverse the main exciting winding, the direction of current in the armature, series compensating winding and shunt compensating winding remaining unchanged.

The power factor of the ordinary series motor is already so satisfactory (·9 being generally reached even at loads well below the normal), that little improvement is necessary. It has, however, been found possible with the Siemens-Schuckert arrangement to reach a power factor of unity over a wide range of load. This is accomplished by making the compensation of the transformer voltage in the short-circuited

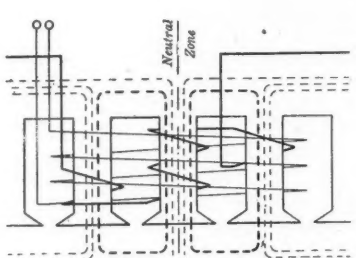


Fig. 6.

armature sections incomplete (*i.e.*, by making the shunt compensating winding too weak). This causes the short-circuit current to shift the main current more into phase with the supply pressure, and so neutralises the inductive drop in the exciting winding. This effect is obtained without an appreciable fall in efficiency, because, since the short-circuit current is almost in phase with the cross flux in which the short-circuited conductors lie, a useful torque is exerted by them. Though experiment has shown that an improvement in power factor can be obtained in this way without sparking, it is probable that commutator heating would occur through the increased short-circuit currents, and, on this account, the method would only be adopted in special cases.

It will be of interest, in conclusion, to insert the comparison made in the article between the above improved series motor and the Winter-Eichberg compensated repulsion motor, together with Dr. Eichberg's comments (*E.T.Z.*, August 16th, 1906) on this comparison:—

1.—Starting.

Dr. Richter.	Dr. Eichberg.
Both motors require main transformers to reduce the terminal pressure at starting. Even then, the repulsion motor draws a larger line current for a given torque, because the working flux has to be reduced at starting.	Dr. Eichberg gives a curve comparing the kilowatts taken at starting by a 28-H.P. Siemens-Schuckert motor, and a 15-H.P. Winter-Eichberg motor, and this shows that for a given torque the power taken by the latter is less than that of the former.

* The Siemens-Schuckert motors have uniformly slotted stators, like those used for induction motors, and the exciting winding encloses all but one of the teeth per pole, so that with, for instance, eight slots per pole, the ratio pole breadth / pole pitch is $\frac{7}{8}$ = ·875.

2.—Sparking.

Dr. Richter.

In the Siemens series motor the reactance voltage is neutralised automatically at all loads, whilst in the repulsion motor this compensation (at least for the main brushes) is impossible.

The transformer voltage can also be neutralised at every load in the Siemens motor by hand regulation of the shunt compensating coil, whilst in the repulsion motor, even when both main and exciting transformer are regulated, complete compensation of the transformer voltage can only occur at synchronous speed.

Dr. Eichberg.

If special compensating windings are to be considered admissible, the reactance voltage of the coils under the main brushes of the repulsion motor can be neutralised sufficiently exactly for practical purposes by providing a small compensating magnet, whose winding is directly connected across the exciting brushes of the motor.

As regards automatic compensation for the transformer voltage, both motors are alike. In neither can the compensation be complete without hand adjustment, whilst with hand adjustment the repulsion motor, like the series motor, can be provided with an auxiliary winding, at least for speeds above synchronism.

3.—Power Factor.

Dr. Richter.

By means of the short-circuit currents under the brush, the power factor (which is already generally over ·9) can be raised to unity if necessary.

Dr. Eichberg.

The increase of these short-circuit currents cannot be considered a satisfactory solution.

Although, theoretically, the power factor of the repulsion motor is unity only at synchronism, it actually keeps between ·96 and 1 over a very wide range of load—a result which cannot be equalled by any series motor.

4.—Economy in Material.

Dr. Richter.

The output of the Siemens-Schuckert motor for a given carcass, a given number of poles, and a given flux density, is improved by the fact that a large polar arc (up to ·875 of the pole pitch) is employed. This would not be possible with a direct-current machine, because for the same maximum flux density, the product of effective amperes by field turns is some 40 per cent. greater with direct than with alternating current.

With this type of field winding, the flux per pole of the series motor will be greater than that of the repulsion motor (whose armature excitation gives a triangular flux distribution) in the ratio of $\frac{\cdot 875}{\cdot 5}$, and even if the iron saturation is chosen so as to convert the triangular distribution into a sine wave one in the repulsion motor, the excess of flux (and of output) is still some 35 per cent. in favour of the series motor.

Dr. Eichberg.

The assumption of equal maximum flux density is quite incorrect as a basis for comparison. The more correct basis would be equal iron loss, and, as is well known, these are lower in the repulsion motor than in the series motor.

5.—Efficiency.

Dr. Richter.

The iron losses are slightly lower in the repulsion motor. The copper losses (due to the presence of the exciting current in the armature) are slightly greater, and the brush friction is greater because of the additional exciting brushes. On the whole, therefore, the total losses in the two types are about equal, and since the output of the series motor is greater, its efficiency will be greater.

Dr. Eichberg.

Allowing for the lower power factor of the series motor, its copper losses are greater by quite 1 per cent., whilst the increased losses due to the armature magnetising current only amount to ·2 or ·3 per cent.

Conduit Enamel.—The Simplex Conduits, Ltd., claim that, after lengthy experimenting, they have secured an enamel for coating their conduits and fittings, which possesses a degree of tenacity and flexibility such as is required to enable tubes to be bent without any fracturing of their protective covering. They will send samples to any of our readers on application.

SOME PRACTICAL NOTES ON THE COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY UNDERTAKINGS.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.I.C.E.

Electric Signs.*

It is most essential to hang out an electric sign in front of the central station showroom—a sign that can be seen at night some distance up and down the street. On no account should a cheap, poorly lit sign be employed, yet, on the other hand, too elaborate a scheme should be avoided. It must give ample light, so as to be an example worthy of emulation by the business men on the street, acting as an incentive to them to increase their lighting and to get signs for their own use. In any case it does not do to advocate a system of advertising which, at the same time, is apparently not considered worth adopting for the benefit of the central station itself. Let the central station rather lead the way by putting up a suitable sign of its own.

The use of signs, properly encouraged, will not only mean the lighting of the same from dusk to the shop closing hour, but will eventually result in their being kept lighted until about eleven o'clock—that is, to the time of night after which all the people will have gone home when the various entertainments are over. This after-closing-hour illumination of signs and show windows is gradually beginning to be appreciated as a valuable feature by shopkeepers all over the country, since it is realised that, though the shops are closed, there are many passers-by whose attention will be drawn to the shop by the sign, and to the articles displayed by the lighted window, bringing to their attention many wares that might not otherwise have been known about. This form of advertising appeals to the people that the shop-keepers are anxious to reach, people who are occupied by day and are unable to visit the shops to select or make purchases, except on the one or two late closing nights of the week.

By actual figures it can be shown to a dealer that—space, effectiveness and circulation considered—an electrical sign and a well-lighted show window form the cheapest as well as the best advertising means he can employ. As a mode of advertising it can be compared with the newspaper, and his attention can be drawn to the fact of how much more valuable it is, how many more people see it, how economically it is maintained, how much more attractive it is, &c., and yet, at the same time, the actual cost of an evening's illumination is less than that of a reasonable space in the local newspaper. These arguments can, of course, be put forward in such a way that the newspaper is not deprecated as a means of advertising, or the withdrawal or discontinuance of newspaper advertisements advocated, and, at the same time, the real value can be impressed upon a man as to the importance of a sign in acquainting people with his name and the situation of his business.

Since the lighting of electric signs for long hours is, of course, very profitable to the central station, everything possible should be done to encourage it. In wiring the shops, switches should be so arranged as to be accessible from the outside, so that the sign and show window lights may be turned on and off without the necessity of unlocking and entering the shop. In some towns a night watchman is employed by the shopkeepers, who, in addition to his other duties, switches the lights on and off at given hours. As an alternative, it may be advisable for the central station to arrange to do this work. In the latter event, however, care must be taken to keep accurate time, as the merchants will naturally object if their lights are burned beyond the stipulated period, when they are paying for the energy consumed on a meter basis. There are now a number of reliable time-switches on the market that can be employed for the purpose of turning the lights on and off. A merchant, when persuaded to adopt one of these means of turning his lights on and off, will always burn them longer hours than if he had to attend to it personally. If a number of the shops use long-hour light-advertising in this way, it will not be a great while before the remainder follow

* Previous articles of this series appeared on pages 650-1, 656-7, 728-9, 808-9, 849-850, 888-9, and 929-30 of the current volume.

suit. It should be impressed on shopkeepers that a bright light always attracts attention, and, therefore, the lighting of their signs and show windows is to be regarded as an advertisement rather than as a mere matter of getting sufficient light. The central station should be prepared to offer the same rates for lighting show windows as for signs.

While great use has been made in this country by the shopkeepers of outside show window lamps with the name painted on the side facing the street (in imitation presumably of the gas lamps), very little has been done in the installation of electric signs proper, that is to say, signs which can be read at some little distance. The use of such signs in most towns is confined to the theatres, though the shopkeepers of some of the larger cities are beginning to appreciate their value as an advertisement.

In London the use of signs is rapidly extending, and at Newcastle, for example, the lighting company are making an active and successful canvass for sign customers. In America, owing to the recent awakening to the necessity for the development of the commercial side of the electric supply business, great strides have been made in the installation of electric signs, and though the conditions in that country are somewhat different to what they are here (though not so much as one who had not been there might, perhaps, think), the following figures will, doubtless, be of interest as indicating the possibilities of the extension of this class of business in this country. In towns of under 10,000 population, the average is one sign to 1,464 people; in towns of between 10,000 and 20,000, one sign to 1,320 people; in towns between 20,000 and 50,000, one sign to 1,458 people; in towns of over 50,000, one sign to 870 people; this making an average of all towns of one sign to 988 people. A conservative estimate of electric signs in the United States, places the number at 75,000, consuming an average of not less than 480 watts per hour each, or a grand total of 36,000 units per hour—figures which make one realise that there is a good income to be obtained by the sale of current for electric signs.

This sign business did not spring up of itself, as some other branches may be considered to have done, it had first to be created, next cultivated, and then given careful attention. The general conclusion that is to be gathered from the American sign business is that it is only in the towns where some plan has been put into effect to eliminate the first cost of the sign to the consumer, that it is a thorough success. This so-called "Free Sign" plan, really "rented sign" system is one that should be carefully looked into, as it possesses many valuable features, and is an excellent means for increasing profits. It is carried out in two different ways. One is for the central station to purchase the sign, and to install it free for a customer, provided the latter agrees to consume a minimum amount of current per month, and for a certain length of time (usually two years.) The amount and time are fixed so that the central station is justified in making the expenditure for the sign. (This may be called the minimum current guarantee plan.) The other way is for the central station to charge a flat weekly or monthly rate for the use of the sign and current during certain hours. This rate also is sufficient to pay for the current consumed, about 20 per cent. per annum on the initial investment in the sign, and any other expenses incidental to the proposition. (This may be termed the controlled flat rate plan.) In both cases it is very advisable to add a sum sufficient to cover the cost of cleaning the sign and for free lamp renewals.

To illustrate the above-mentioned methods, assume that a high-class, double-faced, five-letter, 16 in. high, interchangeable enamelled iron letter sign is required. Such a sign will have about 88 lamp sockets, it will weigh about 200 lb. and will cost about £15. The cost to the central station, assuming, as a very conservative figure, that the life of the sign is five years, will be about £4 per annum (allowing a total of £5 for wiring, hanging and changing for other customers during the five years). The lamps used should be 2 C.P. (special 10-watt), so the total consumption will be 880 watts per hour, and the total current consumption per annum, if the sign is kept lighted an average of four hours a night, will be 1,460 hours × 880 watts, or 1,284 units (107 units per month). On the minimum current guarantee plan, the guaranteed figure per month should therefore be 107 units; the rate charged for current being the rate per unit decided upon as fair for that class of business, plus the proportionate cost of the sign, £4, divided by 1,284·5 units per unit, that is, nearly 0·75d. On the controlled flat-rate plan, the monthly charge is based on the proportionate cost of the sign per month, plus the value of the current consumed at the regular sign rate. This figure is sometimes divided by the number of the lamps, as a flat rate per lamp often appears to be a very attractive price. On this idea of making the charge appear low, some lighting companies are charging by the week, as they find that many a shopkeeper will willingly pay an amount weekly which, if allowed to accumulate into a quarterly bill, would cause him to complain bitterly.

An electric sign should be considered as an advertising investment, and if the impression it makes is not a good one the money invested in it is more than thrown away. An electric sign should lend a distinguishing air of quality to a shop, and it is this element which gives it its greatest value. While an electric sign will designate a place of business, and, perhaps, the nature of that business, a large part of its value lies in the impression it makes. Hence only the best and most permanent types of sign should be encouraged, no matter how small they will have to be to meet the price the consumer can afford to pay. Unsightly transparencies and perforated signs illuminated from the interior are an obstacle to the proper advancement of a sign business, as their general effect is so poor; and strange as it may appear, if properly lighted, the cost of operation is nearly as much as that of a standard type of sign, since 16-C.P. lamps have to be employed instead of 2 C.P.

Some of the essentials of a good sign are that it should be made of the very best materials, carefully put together and simple in construction, so that it may be very durable. It must be waterproof and have a surface, preferably of enamelled metal, that will not fade or lose its colour. The mechanical arrangements for its suspension must be such that it is rigidly and safely supported, not only actually but also in appearance. The lamp sockets and the wiring must be so chosen and arranged that there is not likely to be any trouble from short circuits. If the sign is owned by the central station, it is very important that the letters should be interchangeable to such a degree that, should the customer for whom the sign is first purchased not renew a contract, it can be used for another customer at small expense, and this accomplished without affecting the durability.

Without a sign which corresponds to the above specification, all the propositions, advertising, and salesmanship in the world cannot make a success of a sign business.

Special low current rates for signs are not anywhere near as satisfactory an inducement in the building up of a sign business as the "free" sign proposition is. The reason for this is the well-worn one—lack of capital.

Many of the smaller shopkeepers who, under favourable circumstances, are the great users of signs, either have not the capital or do not care to risk what is to them a comparatively large portion of their reserve fund in an investment of this kind. These small dealers will pay very high flat rental rates where no argument could induce them to buy a sign at any price.

A further argument in favour of the so-called "free" sign propositions is that a steady *late* burning of all the signs connected to a system is obtained, whereas with a special current rate on the meter, the owner of the sign will burn it for a brief period only, and that at the peak of the load, thus becoming a somewhat objectionable addition to the system instead of an advantageous one. What the proposition amounts to is that when the central station has control of the signs, their earning power is about double what it would be if the shopkeepers owned them.

Propositions however good will amount to very little if the prospective sign customers are ignorant of them. It is one thing for a canvasser to know that he can make certain concessions and inducements in favour of electric sign users, and another thing for the man who might thereby be influenced to put up a sign, to realise these facts. The questions of advertising and salesmanship should therefore figure very prominently in all plans for increasing the number of the signs on a distributing system. The average

shopkeeper not only does not realise what propositions are available to suit his case, but he has not even thought of installing such a thing as an electric sign. He has to be educated to the value of the electric sign in commercial life, started thinking about them, and then have the matter brought to his attention again and again.

While there is no objection to signs that are placed flat against a building, very often exception is taken by the street authorities to signs extending across the pavement. This is a matter that should be tactfully taken up with the local streets committee. The reasons for allowing such signs to be installed, are more in their favour than against them. These signs light up the streets at the expense of the shopkeeper, instead of the town, and they give the town a metropolitan appearance, which attracts trade from the surrounding country districts. Proper regulations for the installation of signs should be drawn up, or existing ones revised. Strict regulations as to wiring and hanging are not a detriment, for it hurts the central station more than anyone else, if a short circuit is caused by defective wiring or if anyone is injured in an accident resulting from improper hanging. It is advisable that the central station authorities should devote their attention to the drafting of suitable regulations to form the basis of a suggestion to the Streets Committee, as in this way the matter will be put in good shape more promptly, and there will not be any annoying vagueness in description that might be interpreted to the detriment of the central station interests.

In connection with municipal electrical undertakings, these "free" sign propositions may be objected to on account of their savouring of municipal trading, but such schemes should not be considered in this light, as they are essentially a portion of the distributing means, a legitimate and requisite factor for the successful operation of an electric light and power plant.

After all, electric signs are but a step in the placing of the product of the central station in the consumer's hands in a usable shape—a little poorer form of investment than engines and dynamos, better than the distribution system, and much better than arc lamps (loaned on somewhat the same basis).

THE CONFERENCE ON WIRELESS TELEGRAPHY.

In connection with the articles and correspondence on the above subject which have recently appeared in these columns, the following summary, taken from an article by Chief Postal Inspector W. Meyer, in *E.T.Z.*, December 6th, 1906, of the chief points embodied in the signed agreement and its various appendices will be of interest.* The agreement itself, signed by all the delegates, consists of 23 articles:—

Art. 1.—The contracting parties will ensure that all (public) coast stations or (public or private) ship stations under their control shall comply with the requirements of the present agreement.

Art. 2.—A "coast station" shall be any wireless telegraph station on land or on a permanently anchored ship which engages in the interchange of messages with ships at sea. A "ship station" shall be any station on board a ship which is not permanently moored.

Art. 3.—Coast and ship stations shall exchange messages with one another without distinction as to the wireless system employed.

Art. 4.—Exceptions to Article 3 are permissible under special circumstances not dependent on the system employed.

Art. 5.—All coast stations shall be connected by special lines or other means with the land telegraphic system.

Art. 6.—Information as to the names and other particulars (as required in Article 4 of the appendix) of all coast and ship stations shall be mutually interchanged by the contracting parties.

Art. 7.—The parties retain the right of employing additional apparatus for the receipt or transmission of messages, besides that disclosed in accordance with Article 6, without making the details of such apparatus public.

Art. 8.—The stations are to be arranged as far as possible so as not to interfere with the operation of other stations.

Art. 9.—All stations are required to give immediate attention to distress signals from ships.

Art. 10.—The charge for wireless telegrams shall consist of—

1. The charge for the sea transmission, which is made up of (*a*) a "coast charge" due to the coast station, and (*b*) a "ship charge" due to the ship station.
2. The ordinary charge for transmission over the land telegraph system.

The amount of the "coast charge" is to be determined by the State to which the coast station belongs, the "ship charge" by the State whose flag the ship carries. Both charges are to be based on the actual cost per word, and must not exceed a maximum value to be determined by the contracting parties. Special charges may, however, be made in the case of stations having a range exceeding 800 km. or in the case of stations erected or worked at great expense.

Art. 11.—The requirements of the present agreement are explained in greater detail in an appendix on methods of operation, which is on the same footing, and comes into force at the same time as the agreement. The articles of the agreement, and of the appendix, may be altered at any time by mutual agreement. From time to time, conferences of fully-empowered delegates, or of managing officials (according as the matters to be discussed deal with the agreement itself, or with the appendix) shall be held.

Art. 12.—The delegates shall be nominated by the respective Governments. Each country shall have only one vote. Later conferences may permit colonies or protectorates to be considered as separate countries, but in no case is any one country, including its colonies and protectorates, to possess more than six votes.

Art. 13.—An international bureau shall be instituted, which shall deal generally with the collection and classification of information on wireless telegraphy, as affecting the agreement.

Art. 14.—All the contracting parties retain the right to forward telegrams to, or receive them from, stations belonging to countries which are not signatories to the present articles.

Art. 15.—Articles 8 and 9 of this agreement apply also to wireless stations other than those mentioned in Article 1.

Art. 16.—Countries which are not at present signatories to the agreement may become such on application.

Art. 17.—Articles 1, 2, 3, 5, 6, 7, 8, 11, 12 and 17 of the International Telegraph Convention held at St. Petersburg in 1875, apply to international wireless telegraphy.

Art. 18.—Deals with the question of arbitration in the settlement of doubtful points in the Articles.

Art. 19.—The contracting parties agree to take the necessary legal steps to ensure compliance with the agreement.

Art. 20.—Information will be exchanged as to the laws of the various countries which bear on the subject of the agreement.

Art. 21.—The parties retain full freedom with regard to wireless stations not mentioned in Article 1, especially naval and military stations, except as regards the requirements of Articles 8 and 9.

Art. 22.—The present agreement comes into force on July 1st, 1908, and remains in force *sine die*, or until one year after notice of withdrawal has been given. The withdrawal applies only to the country or countries giving notice, and the agreement continues in force for the remaining countries.

Art. 23.—Deals with the ratification of the agreement.

Chiefly to meet the views of the British and Italian delegates, the following seven additional articles were embodied in a separate codicil:—

1. Deals with the question of obtaining votes for colonies or protectorates.
2. Any of the contracting parties can exclude certain stations from the conditions imposed by Article 3, provided one or more new stations, in accordance with Article 3, are erected in their place. In such cases notice must be given at least three months before the Convention comes into force.

The following countries declare already that they will make no use of this permission:—Germany, America, Argentine, Austria-Hungary, Belgium, Brazil, Bulgaria, Chile, Greece, Mexico, Monaco, Norway, Netherlands, Roumania, Russia, Sweden, Uruguay.

3. The way in which the conditions of the last article are carried out is left in the hands of the Government concerned, which can also determine from time to time how many and which stations shall be excluded from the conditions of Article 3 and how they are to be replaced.
4. To avoid interference with the progress of science, it is understood that the employment of a new form of wireless telegraphy, by means of which communication with existing stations is impossible, is not prohibited, provided that the impossibility lies in the nature of the system and not in the adjustment or method of using the apparatus.
5. Deals with the admission of Colonies, &c., to the Convention and the proprietorship of stations on ships from Colonial ports.
6. The Italian delegates, in signing the agreement, make the reservation that in the case of Italy the requirements of the agreement only come into force after the expiration of the existing agreements with Marconi and his company or with their consent.
7. In case one or more of the signatory parties fails to ratify the agreement, the latter still holds good as regards the parties who do ratify it.

The delegates of Germany, America, Argentine, Austria-Hungary, Belgium, Brazil, Bulgaria, Chile, Denmark, Spain, France, Greece, Monaco, Norway, the Netherlands, Roumania, Russia, Sweden, Turkey and Uruguay further subscribed to the three following additional articles:—

1. Every ship station referred to in Article 1 is bound to exchange messages with every other ship station without distinction of system.
2. Governments which have not yet subscribed to the above article may do so at any time in accordance with the method described in Article 16, whilst Governments desiring to withdraw from this subscription may do so in accordance with Article 22.
3. Deals with the ratification of these additional articles.

* Since this article was set in type, the British Government has issued a Parliamentary paper, No. 368, giving the full text of the Convention, &c.

The most interesting part of the document from a technical point of view is the appendix to the agreement proper, dealing with the actual methods of procedure to be employed. This consists of 42 Articles, which are briefly summarised below:—

Arrangement of the Stations.

1. The choice of system shall be open, and the arrangement shall, as far as possible, keep abreast of the technical and scientific progress of the subject.

2. Two lengths of wave, 300 and 600 metres, are permissible for ordinary work, and every public coast station shall employ one or the other of these, and must be in a position to receive messages with this length of wave throughout the working hours. A Government can, however, permit a coast station to use another wave-length (less than 600 metres, or greater than 1,600 metres) for special long-distance work, or for other than public service.

3. Ship stations shall use a normal wave-length of 300 metres, and shall be in a position to receive such waves. Other wave-lengths not exceeding 600 metres may be employed. Ships with insufficient available space for 300-metre wave apparatus may obtain permission to use shorter waves.

4. The International Bureau will compile a register of stations, giving:—(1) Name, nationality and geographical position for coast stations, and name, nationality distinguishing mark in the International Signal Book, and home port, for ship stations; (2) calling signal (all of which must be different, and each of which must consist of a combination of three letters); (3) normal range of transmission; (4) system of wireless telegraphy employed; (5) nature of receiving apparatus (printing apparatus, sounding apparatus, &c.); (6) lengths of wave employed (the normal length being underlined); (7) service for which the station is employed (public service, partial public service such as to ships only, or to ships of a certain line, or to ships fitted with apparatus of a particular system, long-distance service, private service, official service, &c.); (8) working hours; (9) coast charge, ship charge.

5. The interchange of unnecessary signals or words is prohibited, and experiments from these stations are only permissible if they do not interfere with the working of other stations.

6. No ship station may be erected or worked without a Government licence. Every ship station must comply with the following conditions:—(*a*) The system employed must be a tuned one. (*b*) The transmitting and receiving speed must be at least 12 words of five letters per minute. (*c*) The power delivered to the wireless telegraph apparatus must not exceed 1 kw. under normal conditions. A greater power may be employed if the ship has to transmit messages over a distance of 300 km. or more to the nearest coast station, or if, owing to special difficulties, the greater power is necessary, the ship station must be worked by a Government certified operator. The certificate must show that the operator (*a*) is conversant with the arrangement of the apparatus, (*b*) can transmit or receive at a rate of 20 words a minute, (*c*) is acquainted with the regulations for wireless transmission.

7. In case of unsatisfactory working the authorities may withdraw the operator's certificate (in case he is to blame) or may withdraw the ship's licence (in case the apparatus is at fault or in case the trouble was due to orders given to the operator). In case of repeated trouble from one ship in spite of warning given, the coast stations may be ordered to refuse messages from the ship in question. The case may be submitted to arbitration in accordance with Article 18.

Working Hours.

8. As far as possible an all-day and all-night service shall be maintained at coast stations, but certain stations may be exempt from this requirement. When continuous service does not exist, all telegrams in hand for ships must be forwarded to them, and telegrams must be accepted from them, even if the ship notifies its presence after the working hours, but before the actual stoppage of work.

9, 10 and 11 deal with the forwarding and addressing of telegrams.

12. The "coast charge" shall not exceed 60 centimes per word, nor the "ship charge," 40 centimes. A minimum charge equal to that for 10 words may be enforced.

13. The country in which the coast station which forwards a telegram from a ship to another country is situated, will, as far as charges are concerned, be considered as the starting point for such telegram.

14. The whole cost of a wireless telegram must be borne by the sender. Ships must, therefore, carry the necessary tables of charges, but in case of need they may obtain information on the point from the coast station.

The Forwarding of Telegrams.

15. The International Morse code shall be used.

16. Ships in distress shall employ the signal . . . — — — . . . repeated at short intervals, and any station receiving this signal must interrupt other correspondence and attend to it.

17. The addition of . — — . — . — . . . "P R B" to the call signal indicates that the International Signal Code Book is to be used.

18. Deals with the order of transmitting telegrams.

19. A ship calling up a coast station should first signal when within 75 per cent. of the normal range of the coast station. Before calling, the ship must set its apparatus to the maximum sensitiveness and make sure that the coast station is disengaged.

20. Deals with call and reply signals.

21. When no reply is received on making the calling signal, an interval of half an hour must be allowed to elapse before repeating the signal.

22 to 30. Deal with the details of forwarding, *e.g.*, the method of recording the ship's position, notification of the number of words to be transmitted, how to deal with several simultaneous calls, &c.

Delivery of Telegrams.

31. When a message from a ship cannot be delivered to the addressee, a signal to that effect shall, if possible, be sent to the ship. The same applies to messages forwarded to a ship.

32. In case the ship for which a message is intended does not notify itself to the coast station within 29 days the forwarder will be notified. The forwarder can then, at his own charge, ask the coast station to keep his telegram open for transmission for a further 30 days. Failing this request, the telegram will be put aside as unsendable after 30 days. If the coast station knows that the ship has already gone out of range before the telegram could be forwarded to it, a notification to this effect will be sent to the forwarder.

33. Deals with telegrams which will not be accepted.

34. The telegraphic records will be filed for reference.

35 and 36. Deal with certain points in connection with the charges for telegrams (on the whole, the rules of the International Telegraph Convention apply).

37. The International Telegraphic Bureau will (subject to the agreement of the Swiss Government and of the Universal Telegraph Union) be charged with the duties mentioned in Article 13. The annual cost of this is not to exceed 40,000 fr., exclusive of the special costs of any international conferences.

38. Deals with the duties and publications of the Bureau.

39. Special facilities will be given to shipping agencies for obtaining information as to accidents at sea and information of general shipping interest.

40. The interchange of signals between ship stations must not interfere with the public service of the coast stations.

41. All the above rules apply also to ship-to-ship transmission, except that (*a*) (see 14) the charge for transmission is paid by the sender and that for receipt by the addressee; (*b*) (see 18) the order in which messages are transmitted must be arranged by the two stations; (*c*) (see 34) the charges are not subject to the Government discount.

42. The working conditions attached to the International Telegraph Convention apply to the present Convention, in so far as they do not contradict the above requirements.

An examination of these various articles leads to the conclusion that whilst Germany has obtained the agreement of the Conference to the point which she chiefly insisted on, viz., free interchange of messages between stations of all systems, England has lost little by her adherence to her agreements with the Marconi Co.; for though Marconi stations may not exchange messages with ships not fitted with Marconi apparatus, the English Government is at liberty to erect other stations for general exchange. In this respect the Italian Government is worse off, as its agreements prevent it not only from exchanging messages with other than Marconi stations, but also from employing other than Marconi apparatus.

ELECTRIC COAL-CUTTING.

There was recently issued by the Home Office, a Blue-Book in which were many things of interest to those concerned with the use of electricity in mines. We refer to "Mines and Quarries: General Report and Statistics for 1905—Part II.—Labour." In regard to accidents, it is mentioned that of the six explosions classed as miscellaneous or unknown, four were due to electricity, and of these two were caused by electrical coal-cutting machines.

It is stated that "these ignitions of fire-damp by electrical coal-cutters point to a serious risk from their use in fiery and dusty mines. The rough usage and great vibration to which coal-cutting machines are subject are conducive to failures of insulation, which may cause sparking outside the machines; in addition to which there is the risk that joints and fittings intended to be flame-tight may not actually be so. It must be borne in mind that electricity may be used for working coal-cutters, without these risks, by the intervention of electrically-driven air compressors fixed in the intake air-ways."

In regard to "sundries underground," it is stated that the most important accidents under this head are those due to electricity. In 1905 there were five fatal electrical accidents underground as against seven in 1904. In three cases the persons killed had nothing to do with the working of the electric plant, but received shocks from defective cables.

At Newbattle Colliery (East Scotland district) a young man received a fatal shock through touching a steel girder which was in contact with a lighting cable, the tape insulation of which was damaged so that the bare wire was in contact with the girder. The voltage was about 450.

In Holytown, No. 13 pit (West Scotland district), a fireman received a fatal shock while assisting to work an electrical coal-cutter by coming in contact with the live heads of pinching screws for holding the terminals of the power cables. The pinching screws were not properly insulated. Voltage 500.

At Broughton Moor Colliery (Newcastle district) a miner received a fatal shock while walking out from his work by coming in contact with a broken signal wire, one of the broken ends of which was resting on an armoured electric cable charged with a positive current at 500 volts. The insulation of the cable was defective near the point, allowing a short circuit to take place from

the core to the armouring and thence through the broken signal wire and deceased's body to earth.

At East Ince Hall Colliery (Liverpool district) a drawer received a fatal shock through his tub becoming derailed and cutting through the insulation of a cable suspended by the side of the road.

At No. 2 Ty Trist Colliery (Southern district) an electrical pump attendant was killed by an electric shock. The exact manner in which he received the shock could not be ascertained, but a newly inserted fuse wire was found to be in contact with the fuse case, and there was a defect in the switch. The earthing of the plant appeared to have been defective.

Two fatal accidents on the surface caused by electricity are also reported. At Pelton Colliery (Durham district) a fitter received a fatal shock while carrying a portable electric lamp attached to a flexible cable in the blacksmith's shop. Tests made after the accident failed to reveal the cause. The voltage was said to be only 120. At Lletty Shenkin Colliery (Cardiff district) an electrical wireman received a shock, which resulted fatally, during repairs to high tension terminals at a haulage engine on the surface.

Statistics have again been obtained with reference to the use of coal-cutting machines in the United Kingdom. From a table which we give below, it appears that in 1905 there were 295 collieries where coal-cutting machines were at work. The total number of machines employed was 946 (as against 755 in 1904), of which 446 were worked by electricity and 500 by compressed air; the total quantity of coal obtained in 1905 by the aid of these machines was 8,102,197 tons—this is an increase of 2,358,153 tons, compared with 1904, and 2,856,619 tons compared with 1903. The table gives the number of machines, and of collieries, where used, motive power employed, and the quantity of coal obtained by their use in the various inspection districts during the year 1905:—

District.	Number of collieries where machines are at work.	Number of machines.	Worked by		Coal obtained in tons.
			Electricity.	Compressed air.	
East Scotland ...	39	102	54	48	1,099,546
West Scotland ...	33	109	44	65	1,071,736
Newcastle	18	54	14	40	461,450
Durham	28	105	50	55	676,283
York and Lincoln ...	55	247	96	151	2,412,432
Manchester & Ireland	24	53	9	44	216,363
Liverpool and North Wales	31	97	90	7	592,903
Midland	38	130	68	62	1,160,469
Stafford	11	26	14	12	340,327
Cardiff	9	10	7	3	55,650
Swansea	2	4	—	4	4,364
Southern	7	9	—	9	10,674
Total in 1905 ...	295	946	446	500	8,102,197
Total in preceding year	249	755	270	485	5,744,044

This is an excellent advance in electric coal-cutters for one year, with an almost negligible increase in compressed air.

The following figures show the number and type of mechanical coal-cutters employed in the United Kingdom in 1905:—

Kind of machine.	Total number in use.
Disk	580
Percussive	188
Revolving bar	103
Rotary "heading"	24
Chain machines	51
Total in 1905	946
Total in preceding year	755

TRADE STATISTICS OF SWITZERLAND IN 1905.

The annual trade statistics of Switzerland for 1905 recently issued contain some interesting details with reference to the imports and exports of electrical goods.

The imports of other manufactures of glass, including glass insulators, were valued at 30,192 fr. in 1905, as compared with 14,078 fr. in 1904; the imports from Germany amounted to 29,729 fr. in 1905, as against 13,098 fr. in 1904. The imports of electrical apparatus of all kinds and detached pieces not separately mentioned were valued at 3,642,082 fr. in 1905, as against 3,427,845 fr. in 1904; Germany supplies the largest quantities, viz., 2,701,632 fr. in 1905; the imports from the United Kingdom have decreased from 52,504 fr. in 1904 to 47,800 fr. in 1905; the imports from the United States also decreased. The imports of dynamo-electric machinery were valued at 527,250 fr., as against 582,540 fr. in 1904; the imports from Germany decreased from 519,840 fr. to 440,040 fr., and the imports from United Kingdom from 23,370 fr. to 1,140 fr.; the imports from Austria increased from 3,610 fr. to 48,070 fr., and the imports from France from 27,930 fr. to 29,830 fr. The imports of copper, pure or alloyed in bars, sheets, tubes and wire were valued at 11,746,740 fr., as against 10,552,410 fr.; France and Germany possess almost the whole of the trade, the imports from the former country amounting to 6,668,655 fr., as against 6,493,440 fr. in the previous year, and the imports from the latter country to 4,886,090 fr., as against 3,903,740 fr.; the imports from the United Kingdom decreased from 57,760 fr. to 34,185 fr.; Austria-Hungary has doubled its trade, and now accounts for 103,845 fr. The imports of cables of all kinds with armatures for electric conduits, covered copper wire, &c., have rapidly decreased in recent years; in 1903 the value was 1,716,030 fr.; in 1904, 881,910 fr.; and in 1905, 459,680 fr.; imports from Germany decreased from 537,480 fr. in 1904 to 356,600 fr. in 1905, those from Italy from 183,600 fr. to 85,800 fr., and those from Austria from 139,680 fr. to 3,420 fr.; the imports from United Kingdom are insignificant. On the other hand, the imports of common pottery and porcelain insulators has increased from 553,845 fr. in 1903 to 1,099,656 fr. in 1904 and 1,348,656 fr. in 1905; the imports from Germany in 1905 amounted to 951,212 fr. as against 739,347 fr. in 1904; the imports from Austria and the United Kingdom, although small, have slightly increased; imports from France and Italy have decreased. The imports of lamps of all kinds were valued at 572,800 fr. as against 288,627 fr. in 1904; the imports from Germany have more than doubled, amounting in 1905 to 486,800 fr.; imports from United Kingdom are quite insignificant. The imports of machinery not separately mentioned, excluding weaving and spinning machines, sewing machines and agricultural machines, were valued at 14,519,600 fr., as against 10,488,915 fr. in 1904; Germany holds nearly all the trade, the value of the imports from that country in 1905 being 10,019,240 fr. as compared with 7,537,005 fr. in 1904; imports from France increased from 1,112,020 fr. to 1,777,945 fr.; the imports from United Kingdom from 531,830 fr. to 808,785 fr., and the imports from the United States from 425,620 fr. to 635,715 fr.

Exports.—The exports of electrical apparatus of all kinds and detached parts not separately mentioned increased from 1,860,111 fr. in 1904 to 3,144,089 fr. in 1905; of this latter France took 945,164 fr. (485,756 fr. in 1904), Germany 449,385 fr. (250,156 fr. in 1904), United Kingdom 239,220 fr. (183,003 fr. in 1904), and La Plata 93,567 fr. (20,711 fr. in 1904). The exports of dynamo-electric machinery increased from 9,739,421 fr. in 1904 to 12,039,670 fr. in 1905. Of the latter value Germany took 2,557,815 fr. (1,599,282 fr. in 1904), France 2,962,809 fr. (1,933,764 fr. in 1904), Italy 2,400,057 fr. (2,268,621 fr. in 1904), United Kingdom 705,532 fr. (779,438 fr. in 1904), Spain 899,799 fr. (890,883 fr. in 1904), Central America 64,211 fr. (138,500 fr. in 1904), and Brazil 54,640 fr. (91,050 fr. in 1904). Cables of all kinds with armatures for electrical conduits, covered copper wire, &c., were exported to the value of 133,084 fr. as against 84,590 fr. in 1904; to Germany 37,627 fr. in 1905 (12,325 fr. in 1904), France, 30,154 fr. (15,698 fr. in 1904), and Spain 32,408 fr. (11,065 fr. in 1904). Lamps of all kinds were exported to the value of 592,579 fr. as against 452,023 fr. in 1904; to Germany 139,599 fr. in 1905 (158,168 fr. in 1904), to Italy 192,146 fr. (78,529 fr. in 1904), to United Kingdom 21,818 fr. (6,355 fr. in 1904). The exports of other machinery not elsewhere specified except spinning, weaving, sewing and agricultural machines, were valued at 24,142,386 fr. in 1905 as against 20,949,702 fr. in 1904; to Germany 7,793,226 fr. in 1905 (6,046,957 fr. in 1904), France 3,818,771 fr. (2,976,676 fr. in 1904), Italy 3,201,771 fr. (2,346,591 fr. in 1904), United Kingdom 1,425,636 fr. (955,564 fr. in 1904), Egypt 711,482 fr. (1,251,523 fr. in 1904), Central America 546,400 fr. (183,306 fr. in 1904), Chili 311,679 fr. (180,640 fr. in 1904), and La Plata 309,749 fr. (302,701 fr. in 1904).

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

21,288A/06. "Improvements in electric batteries." F. Richmond. (Date applied for under Rule 5 of the Patents Rules, 1905, September 26th, 1906.) November 26th.

26,785. "Improvements in electrical indicators and annunciators." I. H. Parsons. November 26th.

26,789. "Self-generating electric brake." F. Mason. November 26th.

26,810. "Improvements in conduits for laying electric cables." C. G. Warne. November 26th.

26,820. "Improved form of storage battery grid and machine for making same." B. J. B. Mills. (C. A. Gould, United States.) November 26th. (Complete.)

26,829. "Improvements in magnetic compasses and the like." W. T. St. Aubin. November 26th.

26,862. "Improvements in and relating to contact devices." C. Brent, November 26th. (Complete.)

26,867. "Improvements in and relating to electric furnaces." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.) November 26th.

26,872. "Improvements in telephonic receivers." E. A. Graham. November 26th.

26,887. "Electro-magnetic button or counter." H. R. Brown. November 27th.

26,920. "Revolving arm and bracket for attachment to the trolley boom of an electric tram for the purpose of more easily guiding the trolley wheels to the live overhead wire." A. S. Chapman. November 27th.

26,926. "Improvements in or relating to electrical connection devices." W. W. Strode and G. H. White. November 27th.

26,929. "Improvements in electric furnaces." F. E. Roach, November 27th. (Complete.)

26,933. "Improvements in sparking systems for internal combustion engines and the like." P. M. JUSTICE. (Orswell Igniter Co., United States.) November 27th. (Complete.)

26,936. "Improvements in connection with the electrical ignition of internal combustion engines." T. HUNTER. November 27th.

26,940. "Improvements in the construction of electric accumulators." Q. MARINO and E. W. BARTON-WRIGHT. November 27th. (Complete.)

26,941. "Improved method of and apparatus for forming insulation tubes." M. MEIROWSKY. November 27th. (Complete.)

26,950. "Improvements in electrical switches of the rotary type." W. SUMNER. November 27th.

26,981. "Improvements in electric furnaces." A. REYNOLDS. November 27th.

26,982. "Improvements in electro-magnetic ignition devices for internal combustion engines." THE FIRM OF ROBERT BOSCH. (Date applied for under Patents Act, 1901, November 28th, being date of application in Germany.) November 27th. (Complete.)

26,983. "Improved apparatus for detecting whether railway or like points, are in their correct position, and an electrical switch for use therewith." SIEMENS BROS. & CO., LTD., and L. M. G. FERREIRA. November 27th. (Complete.)

26,985. "Improvements in locking frames for operating electrically controlled railway points and signals." SIEMENS BROS. & CO., LTD., and L. M. G. FERREIRA. November 27th. (Complete.)

26,989. "Improvements in protective devices for electric installations." ALLGEMEINE ELEKTRICITATS GESELLSCHAFT. (Date applied for under Patents Act, 1901, November 28th, 1905, being date of application in Germany.) November 27th. (Complete.)

26,990. "Improvements in frequency changers." J. E. NOEGGERATH. (Date applied for under Patents Act, 1901, December 4th, 1905, being date of application in United States.) November 27th (Complete.)

26,995. "Improvements in brush racking gear for dynamo-electric machines." H. LEITNER. November 27th.

26,998. "Improvements in automatic electric car brakes." J. H. K. MCCOLLUM. November 27th. (Complete.)

27,006. "Apparatus for producing oxides of nitrogen by electric process." I. MOSCICKI. (Date applied for under Patents Act, 1901, August 8th, 1906, being date of application in Switzerland.) November 28th. (Complete.)

27,024. "Improvements in circuit-breaking devices." J. G. STATTER. November 28th.

27,049. "Telegraphic transmitting device." I. KITSEE. (Date applied for under Patents Act, 1901, June 21st, 1906, being date of application in United States.) September 28th. (Complete.)

27,060. "Improvements in and relating to means for operating type-setting machines by means of electric currents controlled by register strips." H. DREWELL. November 28th. (Complete.)

27,076. "Improvements in vapour electric converters." F. H. VON KELLER. (Date applied for under Patents Act, 1901, December 5th, 1905, being date of application in United States.) November 28th. (Complete.)

27,099. "Improvements in the electrolytic manufacture of metal wire, strip or the like." S. O. COWPER-COLES. November 28th.

27,104. "Improvements in electrical detecting apparatus for railway signalling." E. C. IRVING and THE BRITISH PNEUMATIC RAILWAY SIGNAL CO., LTD. November 28th.

27,105. "Improvements in and relating to dynamo-electric machines." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) November 28th.

27,107. "Improvements relating to rheostats." P. WOBBER. November 28th. (Complete.)

27,112. "Improvements in apparatus for starting and regulating electric motors." G. C. FRICKER. November 28th.

27,120. "Electro-metallurgical process for extracting copper from its ores." L. JUMAU. (Date applied for under Patents Act, 1901, November 29th, 1905, being date of application in France.) November 28th. (Complete.)

27,122. "Improvements in and relating to means for collecting electricity from electric alternators and for alternate current motors." H. D. B. HOW. November 28th.

27,138. "Improvements in the construction of ceiling roses for electric lights." G. M. BROWNE. November 29th.

27,144. "Sparking plug for use in explosion engines, with adjustable and visible spark." G. A. E. DELALANDE. November 29th. (Complete.)

27,178. "Improvements in telephone transmitters." W. AITKEN. November 29th. (Complete.)

27,204. "New or improved device for circuit closing, indicating power transmitting and other purposes." G. L. ANDERS and A. T. M. THOMSON. November 29th.

27,205. "Improvements relating to electric motors." R. H. PARKER. (Date applied for under Patents Act, 1901, December 4th, 1905, being date of application in the United States.) November 29th. (Complete.)

27,206. "Improvements in and relating to electric arc lamps burning mineralised carbons." I. H. HEGNER. November 29th. (Complete.)

27,210. "Improvements in dynamo-electric machines." H. LEITNER. November 29th.

27,211. "Improvements in systems of electric train lighting." H. LEITNER. November 29th.

27,212. "Improvements in dynamo-electric machines." H. LEITNER. November 29th.

27,215. "Improved agglutinant for consolidating the active material of electric accumulators." Q. MARINO and E. W. BARTON-WRIGHT. November 29th. (Complete.)

27,269. "Improvements relating to electric motors." B. G. LAMME. (Date applied for under Patents Act, 1901, December 4th, 1905, being date of application in United States.) November 30th. (Complete.)

27,285. "Improvements in or relating to interrupters for X-ray high frequency and motor-car induction coils." H. W. C. COX. November 30th.

27,302. "Improvements in and relating to electric conductors." THE BRITISH THOMSON-HOUSTON CO., LTD., and J. E. WOODBRIDGE. November 30th.

27,303. "Improvements in and relating to gearing for electric motors." THE BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) November 30th.

27,317. "Improved device for eliminating interference between telephonic and telegraphic or low frequency currents transmitted simultaneously over the same line." C. DUO. November 30th. (Complete.)

27,318. "Improvements in apparatus for electrically-firing mines or the like." K. SCHAFFLER. November 30th.

27,330. "Improvement in the application of protective devices to electrical transforming machinery." W. H. SAYERS. December 1st.

27,358. "Improvements in and relating to automatic electrical circuit-breakers of the loose handle type." W. P. HAMLYN. December 1st.

27,387. "Improvements in switches and switching arrangements specially applicable for use in connection with alternating current electric motors." A. HOLMES and G. PAGE. December 1st. (Complete.)

27,389. "Improved electric apparatus for curling hair." C. ROLLAND. December 1st.

27,407. "Improvements in electrical sign regulating devices." T. ATKINSON and W. C. SANDERSON. December 1st.

27,419. "Improvements in and relating to coherers for wireless telegraphy." A. MUIRHEAD. December 1st.

27,416. "Improvements in or relating to ignition devices for explosion motors." LA SOCIETE MARCEL MASSON ET CIE. (Date applied for under Patents Act, 1901, July 12th, 1906, being date of application in France.) December 1st. (Complete.)

27,420. "Improvements in electrical heating apparatus." A. REYNOLDS. December 1st.

27,421. "Improved method of electrical heating and apparatus therefor." A. REYNOLDS. December 1st.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

ELECTRIC SWITCHES. British Thomson-Houston Co. (General Electric Co.) 24,853. November 30th.

VAPOUR-ELECTRIC APPARATUS. British Thomson-Houston Co. (General Electric Co.) 24,856. November 30th.

ELECTRIC FIRE ALARM SYSTEM AND APPARATUS. Hawthorn. 24,858. November 30th.

ELECTRIC LIGHTING FITTINGS AND SYSTEMS FOR TRAINS. H. Fairbrother. (Thomas and Lewis.) 26,162. December 15th.

ELECTRICAL MEASURING INSTRUMENTS. Garrard and Ferranti, Ltd. 27,175. December 29th.

GLOBES OR THE LIKE FOR ELECTRIC LAMPS OR OTHER PURPOSES. E. Bohm. 15,996. August 4th.

COATING MACHINES FOR ELECTRIC CONDUCTORS. British Thomson-Houston Co. (General Electric Co.) 17,842. September 4th.

ELECTRIC SIGNALLING SYSTEM FOR RAILWAYS. A. Gardiner. 22,357. November 1st.

ELECTRIC MOTORS. British Thomson-Houston Co. and F. Holden. 22,620. November 4th.

ALTERNATING ELECTRIC CURRENT MOTORS, AND IN CONTROLLING THE SAME. British Thomson-Houston Co. (General Electric Co.) 22,952. November 8th.

CURRENT COLLECTORS FOR DYNAMO-ELECTRIC MACHINES. W. L. Hildburgh. 22,971. November 9th.

ELECTRO-MAGNETS FOR LIFTING, HOLDING UP RIVETS AND THE LIKE. A. Stewart. 23,016. November 9th.

MECHANICAL AND ELECTRICAL REGISTER COUNTING ENTRIES THROUGH TURNSTILES AND THE LIKE AND RECORDING THEM AT A DISTANCE. H. L. Penniket. 24,823. November 24th.

PRINTING TELEGRAPHS. L. Kamm. 24,605. November 28th.

ELECTRICAL TIME SWITCHES. R. F. S. Venner and R. C. Griesbach. 24,951. December 1st.

ELECTRIC LIFTS AND EQUIVALENT APPARATUS. H. C. E. Jacoby. 25,023. December 2nd.

CONDUITS FOR ELECTRIC CONDUCTORS, PIPES AND THE LIKE. J. H. Harradine, J. T. Biddle and L. W. Crosta. 25,687. December 11th.

ELECTROLYSIS OF METALLIC COMPOUNDS OR ORES. E. A. Ashcroft. 26,813A, December 22nd. (Date applied for under Rule 5, Patents Rules 1905. December 22nd, 1905.)

1906.

ELECTRICITY METERS. Siemens Bros. & Co. (Siemens Schuckertwerke Ges.) 302A. January 4th. (Date applied for under Rule 5, Patents Rules 1905, January 4th, 1906.)

ARC LAMPS. Fortuny. 1,410. January 18th. (Date applied for under International Convention, January 25th, 1905.)

ELECTRIC RESISTANCE ELEMENTS. A. J. Boult. (A. L. Marsh.) 2,129. January 27th.

POTENTIAL REGULATOR FOR ELECTRIC CURRENTS. H. Warming. 2,337. January 30th. (Date applied for under International Convention, June 14th, 1905.)

ELECTROLYTIC APPARATUS. E. Hermite. 2,465. January 31st.

AUTOMATIC STARTING DEVICES FOR ELECTRIC MOTORS. A. J. Boult. (O'Brien.) 2,716. February 3rd.

ELECTRICALLY-DRIVEN BORING AND TURNING MILLS, SLOTTING, SHAPING, PLANING, PUNCHING AND SHEARING MACHINES OR THE LIKE. J. G. Stirk. 4,294. February 21st.

JOINT-BOXES AND THE LIKE FOR TELEGRAPHIC AND OTHER ELECTRICAL CABLES. D. Bould. 4,970. March 1st.

GUARDS FOR INCANDESCENT ELECTRIC LAMPS. B. T. Davies. 7,265. March 26th.

ELECTRIC ARC LAMPS. K. Weinert. 8,895. April 12th.

MICRO-TELEPHONES. H. Hellfritsch. 8,945. April 14th. (Date applied for under International Convention, April 15th, 1905.)

ELECTRIC INCANDESCENCE LAMPS. Siemens & Halske Akt.-Ges. 9,109. April 17th. (Date applied for under International Convention, May 17th, 1905.)

EFFECTING FUSION OF MATERIALS BY ELECTRICITY. G. E. Brindley. 11,675. May 18th.

ARMOURED ELECTRIC CONDUCTORS. Kuhlo. 13,693. June 14th. (Date applied for under International Convention, June 17th, 1905.)

ELECTRO-MAGNETIC DEVICES APPLICABLE AS POTENTIAL REGULATORS AND FOR OTHER PURPOSES. M. Barr. 15,613. July 10th.

ELECTRO-MAGNETIC DEVICES APPLICABLE AS POTENTIAL REGULATORS AND FOR OTHER PURPOSES. W. H. Thompson. 15,614. July 10th. (Date applied for under International Convention, July 17th, 1905.)

CURRENT COLLECTORS FOR VEHICLES OR TRAINS RUNNING ON ELECTRIC RAILWAYS OR TRAMWAYS, WITH OVERHEAD CONDUCTORS. P. Dawson. 16,814. July 28th.

TROLLEYS OR COLLECTORS FOR ELECTRICITY. W. H. Hinton. 18,211. August 14th.

APPARATUS FOR WINDING CLOSED IRON CORES FOR TRANSFORMERS, CHOKING COILS AND THE LIKE. Siemens & Halske Akt.-Ges. 20,041. September 8th. (Date applied for under International Convention, September 12th, 1905.)

TELEGRAPHIC TRANSMITTERS. G. C. Marks. (R. W. Barkley.) 295. January 4th.

APPARATUS FOR LAYING PIPES, CONDUITS OR CONDUCTORS FOR WATER, GAS, ELECTRICITY OR THE LIKE. S. Cahn and E. Seeberger. 898. January 12th. (Rights under Patents, &c., Act, 1901, not granted.)

ELECTRICAL FUSES AND BOXES THEREFOR. Veritys, Ltd., and A. E. Gott. 1,881. January 25th.

HOISTING APPARATUS FOR ELECTRIC ARC LAMPS. J. Neu. 2,153. January 27th.

ELECTRIC MEASURING INSTRUMENTS. British Thomson-Houston Co. and F. Holden. 2,158. January 27th.

SYSTEM OF ELECTRIC ALARM BELLS TO INDICATE THE OPENING OF RAILWAY CARRIAGE DOORS WHILE TRAINS ARE IN MOTION. J. S. Kingston. 2,174. January 29th.

WIRELESS TELEGRAPHY. A. W. Turner, H. J. Peers and H. J. W. Ridley. 2,485. February 1st.

SPARKING PLUGS FOR INTERNAL COMBUSTION MOTORS. Simpson, Strickland and Co. and B. H. Joy. 3,760. February 14th.

CONTACT BREAKERS FOR USE IN CONNECTION WITH ELECTRIC IGNITION SYSTEMS FOR INTERNAL COMBUSTION ENGINES. Electric Ignition Co. and F. H. Hall. 4,057. February 19th.